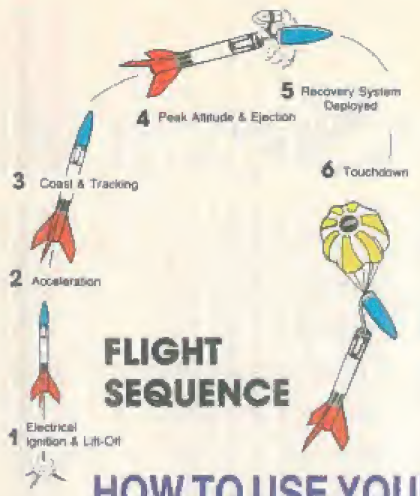
1994 Estes CATALOG

WELCOME TO ESTES MODEL ROCKETRY!

Within the pages of this catalog you will find Estes rocket kits and accessories for every age and skill level! It's never been easier to get started in Estes model rocketry. Try one of our Starter Sets which includes a high flying rocket, engines, and your very own Porta-Pad® II Launch Pad and Electron Beam® Launch Controller. Then move on to our other easy-to-build rockets in the E2X® Series. The Manta™ includes a glider which circles home while the rocket returns with a streamer. The Turbo Copter™ has

turbo-charged helicopter recovery! Collect them all! When you are ready to move up in the Estes rocketry world, go for the Beta Tron™, which has everything you need to build two Beta™ Series rockets, and much, much more. Everyone will love the Estes Rocket Builder's Marking Guide, which makes it quick and easy to mark and measure body tubes for fin placement, circumference, and anything else you need to mark! It even holds fins in place while they dry. Long-time Estes rocketeers and those who are getting back into Estes rocketry will have a blast with our new "E" engines! Choose the Maniac™, which flies on our "C"s, "D"s, or "E"s and builds in less than an hour! This performer flies out of sight and is easily recovered with a fluorescent streamer. The Broadsword™ and The Shadow™ are massive rockets that also use our "D" or "E" engines. Whatever your mood, only Estes holds the excitement for you. The possibilities are endless, the choices are yours. Ignite your imagination!



LAUNCH AREA:

Choose a large field away from power lines, tall trees, and low-flying aircraft. This chart shows the smallest recommended launch areas:

ENGINE TYPE	ESTIMATED ALTITUDE		MINIMUM LAUNCH SITE DIMENSION*	
ALL DELAYS	FEET	METERS	FEET	METERS
1/2A	200	61	50	15
A	400	122	100	30
B	800	244	200	61
C	1,600	488	400	122
D	1,800	549	500	152
E	2,000	610	600	183

Minimum circular area = Diameter in feet or meters
Minimum rectangular area = Shortest side in feet or meters

Launch site must be free of obstructions and highly flammable materials.

HOW TO USE YOUR ESTES CATALOG

To get the most out of your catalog, please read this section. It will help determine what kit fits your needs and what the specifications are of that kit. This catalog is divided into kit series. Each series has a skill level: E2X™ Series (almost ready to fly); Beta™ Series (skill level 1); Explorer™ Series (skill level 2); Challenge™ Series (skill level 3); and Master™ Series (skill level 4); Pro™ Series and Estes R/C are separate product lines. Kits in those series can range from easy to difficult. In this catalog each series contains an introduction that gives you the characteristics of that skill level. Each kit listing gives you the kit name, its product number and price. In addition, you will find a kit description that gives you features, length, diameter and weight. You will also find the engines, from least to most powerful, that we recommend for that rocket. We will sometimes list an engine that we recommend in breezy conditions. "First Flight" indicates which engine should be used to become familiar with your rocket's flight profile.

One of the more important features is the **Kit Feature Symbol.** These symbols will give the size and type of recovery system, type of fins, nose cone, decals and other features. Below is the symbol key:

RECOVERY SYSTEM:

- 24 — Plastic parachute with diameter in inches
- 18N — Nylon parachute with diameter in inches
- Streamer

NOSE CONE:

- Plastic
- Balsa

ENGINE MOUNT:

- Quick release

DECALS:

- PR — Pressure sensitive
- WS — Water soluble

MAXIMUM ALTITUDE:

- 450 — In meters with most powerful engine recommended

FIN TYPE:

- B — Die-cut balsa
- P — Die-cut plastic
- F — Die-cut fiber
- BFS — Balsa stock
- Plastic fin unit

TABLE OF CONTENTS

Model Rocketry is recommended for those age 10 years and up. Adult supervision is recommended for those under 12 years of age.

Use only Estes products with Estes model rockets. Unless specified, all models require assembly. Engines, launch system, glue and finishing supplies are not included with kits unless specified.

Prices may change without notice.

StarterSets

There's no better way to get started in this terrific hobby than with one of our five great starter sets.

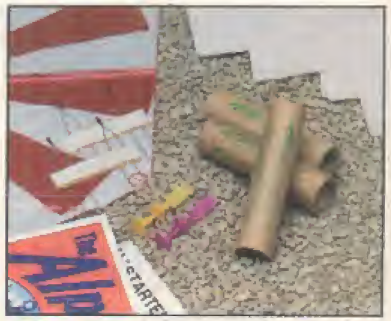
Each set contains a high-flying, easy-to-assemble E2X™ Series model rocket kit. These models assemble so simply and precisely that we guarantee success. And, with pre-finished parts and no painting required, you'll have a sharp looking model ready to go in almost no time!

You also get:

- A Porta-Pad® II launch pad
- An Electron Beam® electrical launch controller
- Cobra® model rocket engines, igniters and revolutionary new igniter plugs for sure-fire launches every time!

Plus, the launch equipment can be used to launch nearly every Estes rocket in the E2X® through Master™ Series!

All of this comes packed in a sturdy range box with a carry handle. You'll save a bundle over individual retail prices. All you need is batteries and glue, and in about an hour, you'll be ready to launch!



*Unless otherwise specified, all models in this catalog require assembly.

StarterSets

PATRIOT™
EST 1450
$26.99

AIRWALKER™
EST 1410
$28.99

Each starter set requires four AA-type alkaline batteries and adhesive - not included.
Avg. Ship Wt. 1.4 kg (3 lbs.)

AIRWALKER™

Sleek sounding rocket styling and a clear cargo bay highlight this sharp performer. Unique chrome-colored body tube, bright red fins and nose cone give this 50.8 cm (20") tall rocket a clean, professional appearance. Includes Cobra® engines and supplies for your first three flights.

Engines: A8-3 (First Flight), B4-4, B6-4, B8-5, C5-3, C6-3, C6-5

PATRIOT™

This rugged, high flier features a scale appearance with military surface-to-air missile decor. Stands 49.5 cm (19.5") tall and features fast, easy assembly, no painting and parachute recovery. Includes Cobra® engines and supplies for your first three flights.

Engines: A8-3 (First Flight), B4-4, B6-4, B8-5, C5-3, C6-3, C6-5

StarterSets

ALPHA® III
EST 1406
$27.99

AMERICA™
EST 1447
$24.99

ALPHA® III

This set features the tried-and-true Alpha® III with bright orange and black decor. Assembly is easy with a one-piece plastic swept-fin unit. Great performance with parachute recovery for safe landings. Includes Cobra® engines and supplies for your first three flights.

Engines: A8-3 (First Flight), 1/2A6-2, A8-5, B4-4, B4-6, B6-4, B6-6, B8-5, C6-5, C6-7

AMERICA™

The 38 cm (15") tall America™ rocket features NASA-style decor and lean lines. Assembly is quick and easy with one-piece plastic fin unit and self-adhesive decals. Fantastic performance flight after flight using parachute recovery. Comes with Cobra® engines and supplies for your first two flights.

Engines: A8-3 (First Flight), 1/2A6-2, A8-5, B4-4, B4-6, B6-4, B6-6, C6-5, C6-7

StarterSets

SUPER SHOT™
EST 1449
$30.99

Each starter set requires four AA-type alkaline batteries and adhesive - not included.
Avg. Ship Wt. 1.4 Kg (3 lbs.)

SUPER SHOT™

This two rocket combo starter set delivers super value and super performance!
The E2X® Series Super Shot™ rocket is the first step and features super-quick assembly, with pre-colored parts and hot decals. 42 cm (16-1/2") tall, tough and durable, it can be launched again and again up to 800 feet high and returns by parachute.
The Twister™ is an Explorer™ Series rocket and includes crazy mind-twisting decals. Instead of a parachute, the 24 cm (9-1/2") tall Twister™ separates into two pieces and spins down helicopter style from up to 1000 foot altitudes! The ideal second rocket!
Includes Cobra® engines and supplies for your first three super flights.

Engines:
Super Shot™ - A8-3 (First Flight), B4-4, B6-4, B8-5, C5-3, C6-3, C6-5
Twister™ - 1/2A6-2 (First Flight), A8-3, A8-5, B4-4, B4-6, B6-4, B6-6, B8-5

E2X® SERIES

E2X®
ALMOST READY TO FLY

There is no modeling experience required in this series. As a matter of fact, the rockets in this skill level are assembled, not constructed. What this means, simply and easily, is that:

- **There is practically no cutting or sanding**
- **There are very clear and simple to follow instructions**
- **There is no painting or sealing**
- **These kits are a very quick build - almost 30 minutes**

These precision engineered kits, with exacting plastic parts and pre-colored body tubes, let the novice assemble a rocket with a craftsmanship result. By including rockets, such as the piston-actuated Cato™, the helicopter-recovered SkyWinder™ and the glider recovered Manta™ in this skill level, there are features that even the experienced modeler will enjoy.

*Unless otherwise specified, all models in this catalog require assembly

MANTA™
EST 2097
$9.99

TURBO COPTER™
EST 2096
$8.99

MANTA™

The Manta™ is the perfect first glider kit! A futuristic foam glider rides piggyback on the booster. At apogee, the glider detaches and circles home. The booster is recovered via a streamer. The Manta™ is easy to build – no painting!

Specifications:
Length: 41.9 cm (16.5"); Dia.: 24.8 mm (0.976"); Wt.: 51 g (1.8 oz.); Engines: A8-3(First Flight), B4-2, B6-2

TURBO COPTER™

Hot stuff! The Turbo Copter™ flies to over 1,000 feet and is super easy to build. This rocket has a wild helicopter-style recovered nose cone, a streamer-recovered main body, fluorescent colors, and hot, trendy graphics.

Specifications:
Length: 35.24 cm (13.875"); Dia.: 18.7 mm (0.736"); Wt.: 25.8 g (0.91 oz.); Engines: 1/2A6-2 (First Flight), A8-3, A8-5, B4-4, B6-4, B6-6, B8-5, C6-5, C6-7

EX® SERIES

Engines, launch system, glue, and finishing supplies not included.
Avg. Ship Wt. 340 g (12 oz.)

OMLOID™
EST 2078
$13.99

- *Launch an Egg!*

- *Midair Break-Apart!*

BAIL-OUT™
EST 2070
$13.99

CATO™
EST 2071
$14.99

OMLOID™
With a huge 51 mm (2") diameter twist-together cargo capsule, you can fly an egg or all kinds of scientific payloads in this multi-purpose launch vehicle. Pre-colored and assembles in minutes! A 46 cm (18") reflective silver 'chute brings it down safely even with heavy payloads. Perfect for school and science fair projects or just plain fun!
Specifications:
Length: 47.8 cm (18.8"); Dia.: 34.2 mm (1.346"); Wt.: without egg - 70.8 g (2.5 oz.); Engines: with egg - C5-3, C6-3, without egg - B4-2 (First Flight), B6-2, C6-5

BAIL-OUT™
Explore interactive rocketry with this model! Can eject your favorite 95 mm (3¾") action figure with a parachute (Sorry, figure is not included but two chutes for your figure are!). Features include plastic fin unit, two 61 cm (24") parachutes for figure, special harness for your figure and easy to build!
Specifications:
Length: 62 cm (24.5"); Dia.: 42 mm (1.64"); Wt.: without figure - 87 g (3.07 oz.), with figure - 104.0 g (3.67 oz.); Engines: B4-2 (First Flight), B6-4 (with no wind), C5-3, C6-3, C6-5

CATO™
The supreme "gag" rocket, this rocket breaks apart into pieces after a short flight, is safely recovered in a small area, and re-assembles in minutes for flight after flight. Internal piston system shows how the ejection charge works in different ways! The Cato™ features multiple recovery systems - parachute, streamer and tumble. The Cato™ is easy to build and to fly!
Specifications:
Length: 51 cm (21.0"); Dia.: 42 mm (1.64"); Wt.: 125 g (4.4 oz.); Engines: B6-0 (First Flight), C6-0

E2X® SERIES

Bandit™, Rampage™ and Dagger™ Kits Feature:

- *Pre-Colored Body Tubes*
- *Plastic Nose Cone and Fins*
- *Pre-Slotted Body Tubes*
- *Stick-On Decals*
- *No Painting*

BANDIT™
EST 2060
$9.99

RAMPAGE™
EST 2061
$10.99

DAGGER™
EST 2062
$11.99

BANDIT™

The perfect beginner's model in a true almost ready-to-fly style. This rocket, capable of blazing performance, will be a guaranteed favorite. E2X™ standard features include slotted body tubes for easy fin alignment and precision engineered for a fast build.

Specifications:
Length: 42 cm (16.5"); Dia.: 25.4 mm (1.0"); Wt.: 45.5 g (1.6 oz.); Engines: A8-3 (First Flight), B4-4, B6-4, B8-5, C5-3, C6-3, C6-5

RAMPAGE™

With slotted body tubes for easy alignment and strong fin attachment, a double thick body tube and plastic nose cone, this rocket will still be flying when the competition has given up. The Rampage™ has a payload section and can be built under an hour.

Specifications:
Length: 44 cm (19.5"); Dia.: 25.4 mm (1.0"); Wt.: 50.2 g (1.8 oz.); Engines: A8-3 (First Flight), B4-4, B6-4, B8-5, C5-3, C6-3, C6-5

DAGGER™

The flagship of our E2X™ series, this rocket is sleek, long and lean. It's a winner whether it's on the pad, in the air or on display. This super quick build features a chrome colored payload section, slotted body tube and pre-finished plastic fins.

Specifications:
Length: 57.0 cm (22.5"); Dia.: 25.4 mm (1.0"); Wt.: 53.5 g (1.9 oz.); Engines: A8-3 (First Flight), B4-4, B6-4, B8-5, C5-3, C6-3, C6-5

Engines, launch system, glue, and finishing supplies not included.
Avg. Ship Wt. 283 g (10 oz.)

GNOME™
EST 0886
$4.59

ALPHA® III
EST 1256
$8.89

GNOME™

This mini-engine entry into the E2X™ level is perfect for small flying fields. The Gnome's great features include an electric blue colored, one piece, plastic fin unit, a chrome colored body tube, and great performance!

Specifications:
Length: 26.04 cm (10.25"); Dia.: 13.8 mm (0.544"); Wt.: 12 g (0.42 oz.); Engines: 1/2A3-2T (First Flight), 1/2A3-4T, A3-4T, A10-3T

ALPHA® III

One of the oldest, most reliable, easiest-to-build rockets has a dynamic decor - glossy black body tube, fluorescent orange plastic fin unit and nose cone. This old-timer is a durable flier and requires no painting.

Specifications:
Length: 31.1 cm (12.25"); Dia.: 24.8 mm (0.976"); Wt.: 34 g (1.2oz.); Engines: A8-3 (First Flight), 1/2A6-2, A8-5, B4-4, B4-6 B6-6, B8-5, C6-5, C6-7

E2X™ SERIES

ATHENA™
EST 2026
$9.59

PEGASUS™
EST 2076
$9.59

Engines, launch system, glue, and finishing supplies not included.
Avg. Ship Wt. 283 g (10 oz.)

ATHENA™

Gleaming and fast, rugged and beautiful, this model can smoke. With white and chrome plastic, the Athena™ will become one of your favorites! Performs great on a wide selection of engines.

Specifications:
Length: 38.1 cm (15.0"); Dia.: 24.6 mm (0.976"); Wt.: 36 g (1.27 oz.); Engines: A8-3 (First Flight), 1/2A6-2, A8-5, B4-4, B4-6, B6-6, B8-5, C6-5, C6-7

PEGASUS™

The new Pegasus™ is ready to become the first in your stable of rockets. This great looking, sleek rocket is quick to build and quick to fly. Features durable and rugged construction and there's no painting required!

Specifications:
Length: 38.1 cm (15.0"), Dia.: 24.6 mm (0.976"), Wt.: 36 g (1.27 oz.); Engines: A8-3 (First Flight), 1/2A6-2, A8-5, B4-4, B4-6, B6-6, B8-5, C6-5, C6-7

Engines, launch system, glue, and finishing supplies not included.
Avg. Ship Wt. 340 g (12 oz.)

SKYWINDER™
EST 2077
$14.99

- *Copters Back To Earth!*

SKYWINDER™

This amazing model assembles fast and launches like any "regular" model rocket, but at the peak of its flight, it transforms! Three helicopter blades with brightly colored decals unfold from the body and start spinning faster and faster, creating a kinetic color display and lowering the SkyWinder™ gently to the ground. It has one piece recovery and preps for flight in seconds - no wadding, parachute or streamer.

Specifications:
Length: 50.8 cm (20"); Dia.: 34.2 mm (1.346"), Rotor Span: 50.8 cm (20"); Wt.: 70.9 g (2.5 oz.); Engines: B4-2 (First Flight), B6-2, C6-3

BETA™ SERIES

BETA™ SERIES
SKILL LEVEL 1

These dramatic, exciting-looking kits will fill many modelers' needs: from the inexpensive Mosquito™ to the hot performing Zinger™ to the payload-carrying Nova Payloader™ to the sensational Big Bertha™

This is a traditional starting point for some modelers. The Beta Tron™ Rocket Builder's Kit is an excellent introduction to this type of model building. The kits in this series have simple construction, although some modeling experience can be helpful (sanding, cutting, measuring and gluing), this skill level will help you acquire those skills. These kits are often used in schools, Boy Scout Troops, 4H Clubs, summer camps, Civil Air Patrol and Young Astronauts programs. The kits feature:

- **Die cut fins with some fin alignment necessary**
- **Simple painting**
- **Pressure sensitive or water transferable decals**
- **Up through "C" engine power**

*Unless otherwise specified, all models in this catalog require assembly

BETA-TRON™

Create, Build and Fly Your Own Designs

ROCKET BUILDER'S SET
An Introduction to Estes Rocket Building

New!

- **Includes Estes Marking Guide which marks tube easily**
- **Easy-to-Use Technical Manual**
- **Custom Decals**

Two of many designs you can build

BETA TRON™
EST 1464
$24.99

The Beta Tron™ is the logical next step after the E2X® Series because it teaches the basic skills of model rocket construction! The cornerstone of this set is the Rocket Builder's Marking Guide™ tool set, a series of tools that makes the construction of model rockets easier (see page 53 for more details on the Marking Guide). This set also supplies everything you need to build two rockets including body tubes (BT-50 size), engine mounts, nose cones, two sets of die cut balsa, self-stick foil and water transferable decals, parachutes and streamer material, and a clear payload section - multiple designs are possible! Also includes a paper altitude tracking device, a modeler's Technical Manual, Model Rocket News, and three engines (A8-3, B6-4 and C6-5) with wadding, plugs and igniters

BETA SERIES

Engines, launch system, glue, and finishing supplies not included.
Avg. Ship Wt. 283 g (10 oz.)

MONGOOSE™
EST 2092
$8.99

MONGOOSE™
The perfect first two-stage rocket! The Mongoose™ has two one-piece fin units, colored body tubes, and it flies to over 1800 feet! This rocket builds very quickly and doesn't need paint. Can also be flown single stage.

Specifications:
Length: 67.3 cm (26.5"); Dia.: 24.8 mm (0.976"); Wt.: 65 g (2.3 oz.); Engines: Single Stage: A8-3 (First Flight), B4-4, B6-4, B8-5, C6-5
Two Stage: Upper Stage - A8-5 (First Flight), B4-6, B6-6, C6-7; Booster Stage - B6-0 (First Flight), C6-0

NINJA™
EST 0882
$4.59

NINJA™
Dark and mysterious, this hot performer flies on mini-engines. Builds quickly and makes an excellent first rocket.

Specifications:
Length: 26.8 cm (10.56"); Dia.: 18.7 mm (0.736"); Wt.: 15.9 g (0.56 oz.); Engines: 1/2A3-4T (First Flight), A3-4T, A10-3T

YANKEE™
EST 1381
$4.59

YANKEE™
This rocket has the performance worthy of an All American - capable of out-of-sight! flights! This model has self-stick adhesive decals, streamer recovery and can use a wide selection of engines.

Specifications:
Length: 27.9 cm (11.0"); Dia.: 18.7 mm (0.736"); Wt.: 11.9 g (0.42oz.); Engines 1/2A6-2 (First Flight), A8-3 A8-5, B4-4, B4-6, B6-6, B8-5, C6-5, C6-7

WIZARD™
EST 1292
$4.59

WIZARD™
You don't need magic to put this rocket up over 1/4 mile high - just plug in a "C" engine and go! A big 76 cm (30") streamer makes tracking and recovery easy.

Specifications:
Length: 30.5 cm (12"); Dia.: 18.7 mm (0.736"); Wt.: 22.4 g (0.79 oz.); Engines: A8-3 (First Flight), 1/2A6-2, A8-5, B4-4, B4-6, B6-4, B6-6, B8-5, C6-5, C6-7

MOSQUITO™
EST 0801
$2.79

MOSQUITO™
Don't let size fool you - the smallest rocket in our fleet moves out fast and flies almost out-of-sight every time! Ultra lightweight construction and fantastic performance.

Specifications:
Length: 9.9 cm (3.9"); Dia.: 13.8 mm (0.544"); Wt.: 2.8 g (0.1 oz.); Engines: 1/2A3-4T (First Flight), A3-4T, A10-3T

THUNDERHAWK™
EST 2002
$8.59

THUNDERHAWK™
Long, lean sport flier featuring super stable five fin configuration. Simple to construct and finish, and delivers impressive performance.

Specifications:
Length: 55.9 (22"); Dia.: 24.8 mm (0.976"), Wt.: 34.6 G (1.22 oz.); Engines: A8-3 (First Flight), B4-4, B6-4, C6-5

BETA™ SERIES

VIKING™
EST 1949
$4.29

YELLOW JACKET™
EST 2008
$7.99

ALPHA®
EST 1225
$7.29

VIKING™
This high flier can be built with three, four or five fins in various arrangements, making it ideal for aerodynamic experiments and comparisons. Easy to build.
Specifications:
Length: 30.8 cm (12.125"); Dia.: 18.7 mm (0.736"); Wt.: 16.5 g (0.71 oz.); Engines: A8-3 (First Flight), A8-5, B4-4, B6-4, B8-5, C6-5, C6-7

YELLOW JACKET™
All around great performance is the hallmark of this terrific sport rocket. This easy-to-build flier features parachute recovery and water transferable decals.
Specifications:
Length: 42.7cm (16.8"); Dia.: 24.8 mm (0.976"); Wt.: 30.6 g (1.08 oz.); Engines: A8-3 (First Flight), A8-5, B4-4, B4-6, B6-4, B6-6, B8-5, C6-5, C6-7

ALPHA®
The Alpha®, after over three decades, is still the perfect first or second rocket. Millions have been made and flown - a very reliable performer that can use a wide variety of engines! There is only one Alpha®!
Specifications:
Length: 31.1 cm (12.25"), Dia.: 24.8 mm (0.976"); Wt.: 22.6 g (0.8 oz.); Engines: A8-3 (First Flight), 1/2A6-2, A8-5, B4-4, B4-6, B6-4, B6-6, B8-5, C6-5, C6-7

Uses ASA 200 Film
Easy to Build

Engines, launch system, glue, and finishing supplies not included.
Avg Ship Wt. 392 g (14 oz.)

ASTROCAM®110 with Launch Vehicle
EST 1327 $26.99

BIG BERTHA™
EST 1948
$10.69

ASTROCAM® 110
Imagine an image, taken hundreds of feet in the air from a rocket. This rocket gives you that ability. The AstroCam™ 110 offers features such as the use of 200 ASA 110 film (film and developing available locally), critical camera parts are pre-assembled and it has a high quality optical-grade lens.
Specifications: - Camera
Length: 16.5cm (6.5"); Dia.: 35.3mm (1.39"); Wt.: without film 38.5 g (1.36oz.), with film - 49.8 g (1.76 oz.); Shutter Speed: 1/500 sec.; F-Stop: 11
Specifications - Camera and Launch Vehicle:
Length: 48.5 cm (19.1"); Dia.: 34 cm (1.34"); Wt.: 106.1 g (3.75 oz.); Engines: C6-7

BIG BERTHA™
Burly, bad and beautiful! One of Estes' oldest kits is one of our most dynamic looking! This rocket has been a favorite of millions of rocket modelers - make it your favorite, too! The mighty "Bertha" sports futuristic self-adhesive decals!
Specifications:
Length: 61 cm (24"); Dia.: 41.6 mm (1.637"); Wt.: 62.3 g (2.2oz.); Engines: B6-2 (First Flight), A8-3 (in no wind conditions), B4-2, B4-4, B6-4, B8-5, C6-5

BETA™ SERIES

ZINGER™
EST 1917
$4.59

SPACE RACER™
EST 2039
$4.29

SPARROW™
EST 0872
$3.99

ZINGER™

Efficient aerodynamic design makes this our best performing single-stage rocket. Easily reaches 610 meters (2000 foot) altitudes, making it an excellent sport or competition model.

Specifications:
Length: 26 cm (10.25"); Dia.: 18.7 mm (0.736"); Wt.: 8.5 g (0.3 oz.); Engines: A8-5 (First Flight), B4-6, B6-6, C6-7

SPACE RACER™

This nifty rocket with the racy looks is easy to build and has "out-of-sight" performance. Features easy-to-finish fiber fins, a special plastic molded nose cone and can use a wide variety of engines.

Specifications:
Length: 32.1 cm (12.625"); Dia.: 18.7 mm (0.736"); Wt.: 20.8 g (0.73 oz.); Engines: 1/2A6-2 (First Flight), A8-3, A8-5, B4-4, B4-6, B6-4, B6-6, B8-5, C6-5, C6-7

SPARROW™

A mini model with big missile decor, this rocket is so lightweight that it only requires break-away recovery for safe landings! Additional features include fiber fins - no sealing required and colorful self-stick decals.

Specifications:
Length: 27.3 cm (10.75"); Dia.: 13.8 mm (0.544"); Wt.: 11.1 g (0.39 oz.); Engines: 1/2A3-2T (First Flight), A3-4T, A10-3T

Engines, launch system, glue, and finishing supplies not included.
Avg. Ship Wt. 283 g (10 oz.)

MINI-PATRIOT™
EST 0896
$4.29

NOVA PAYLOADER™
EST 1960
$9.59

RELIANT™
EST 1986
$4.29

MINI-PATRIOT™

The only mini engine scale (1/22nd scale) model available! This semi-scale version features construction techniques that keep the painting simple. This model features fiber fins - no sealing required!

Specifications:
Length: 25.4 cm (10.0"); Dia.: 18.7 mm (0.736"); Wt.: 17.1 g (0.6 oz.); Engines: A3-4T (First Flight), A10-3T

NOVA PAYLOADER™

With its clear payload capsule, this easy-to-build rocket is perfect for experiments and science projects. A great second or third rocket. A "C" engine will power this model out of sight and a parachute will recover it nicely for its next flight.

Specifications:
Length: 53.7cm (21.1"); Dia.: 24.8 mm (0.976"); Wt.: 37.6 g (1.33 oz.); Engines: A8-3 (First Flight), B4-4, B6-4, B8-5, C6-5

RELIANT™

This hot performer features self-adhesive sounding rocket decals and a quick release engine mount - a perfect beginner's rocket. Can use a wide selection of engines!

Specifications:
Length: 31.8cm (12.5"); Dia.: 18.7 mm (0.736"); Wt.: 17.6 g (0.62 oz.); Engines: 1/2A6-2(First Flight), A3-3, A8-5, B4-4, B4-6, B6-4, B6-6, B8-5, C6-5, C6-7

EXPLORER™ SERIES

EXPLORER™ SERIES
SKILL LEVEL 2

When you have learned the basics of model rocketry and are ready for something new and different, the next step is the Explorer™ Series. This series offers interesting features with more involved construction and finishing. Here you will polish your skills and learn about the variety of fascinating design and recovery possibilities. Glider recovery models like the A.R.V. Condor™ and high flying two stagers offer new dimensions of in-flight excitement. There are scale models and futuristic designs that fly just as great as they look! Or step up to exciting "D" powered models like the Mean Machine™ or Delta Clipper™.

 *Unless otherwise specified, all models in this catalog require assembly.

Engines, launch system, glue, and finishing supplies not included.
Avg. Ship Wt. 340 g (12 oz.)

A.R.V. CONDOR™
EST 2075
$11.79

A.R.V. CONDOR™

This is Estes' dynamic concept of an upper atmospheric vehicle. This NOAA (National Oceanic and Atmospheric Administration) rocket would boost to the high reaches of our atmosphere via the booster vehicle, where the two research drones would detach. In our exciting version, the streamer-recovered booster pops two parasite gliders off at ejection. These "diffuser tip" winged drones glide, circling, chasing each other gently back to the ground. Our kit features an easy-to-build, vacuum-formed plastic mounting system for the gliders and a three-color water-transferable decal.

Specifications:
Booster - Length: 47.0 cm (18.5"); Dia.: 24.8 mm (0.976"); Wt.: 32.0 g (1.13 oz.)
Drones - Length: 15.6 cm (6.13"); Dia.: 13.8 mm (0.544"); Wt.: 14 g (0.49 oz.)
Engines: B4-2(First Flight), B6-2, C5-3, C6-3

EXPLORER™ SERIES

SOLAR WARRIOR™
EST 0895
$4.59

TORNADO™
EST 2004
$4.59

HERCULES™
EST 1377
$12.79

SOLAR WARRIOR™

This colorful mini-engine-powered kit features futuristic styling. Modeled with ion engine pods which help stabilize it for atmospheric flights. Great looks and great performance!

Specifications:
Length: 32.1 cm (12.625"); Dia.: 18.7 mm (0.736"); Wt.: 19 g (0.67 oz.); Engines A3-4T (First Flight), A10-3T

TORNADO™

This rocket features recovery with a different spin. When the engine's ejection charge is activated, the Tornado™ separates into two sections. Each section then spins to the ground in a helicopter-style recovery.

Specifications:
Length: 24.1 cm (9.5"); Dia.: 18.7 mm (0.736"); Wt.: 13.9 g (0.49 oz.); Engines 1/2A6-2 (First Flight), A8-3, A8-5, B4-4, B6-4, B6-6, B8-5

HERCULES™

Reach for the sky with two-stage flights of almost 1/2 mile high! Featuring a clear payload section, this model is ideal for high-altitude payload launching.

Specifications:
Length: 54.9 cm (21.6"); Dia.: 24.8 mm (0.976"); Wt.: 52.1 g (1.84 oz.); Engines: Single Stage - A8-3 (First Flight), B4-4, B6-4, B8-5, C6-5; Upper Stage - A8-5 (First Flight), B6-6, B8-5, C6-7, Booster - B6-0 (First Flight), C6-0

SUPER NOVA™
EST 2011
$11.79

BLACK BRANT II™
EST 1958
$12.79

MINI-COBRA™
EST 0898
$4.29

SUPER NOVA™

This sleek two-stage rocket can easily launch payloads to almost 1800 feet. The Super Nova™ features forward swept fins in the first stage and a clear payload capsule in the upper stage. Can also be flown as a single stage rocket.

Specifications:
Length: 68.6 cm (27"); Dia.: 24.8 mm (0.976"); Wt.: without payloads - 48.1 g (1.7 oz.); Engines: Single Stage Configuration: B4-4 (First Flight), A8-3, B6-4, B8-5, C6-5; Two Stage Configuration: First Stage - B6-0 (First Flight), C6-0, Second Stage - A8-5 (First Flight), B4-6, B6-6, C6-7

MINI-COBRA™

Fly to incredible altitudes with this ideal first two-stage rocket. Like all of our multi-staged models, the Mini-Cobra™ can be flown single-stage too.

Specifications:
Length: 25 cm (10"); Dia.: 13.8 mm (0.544"), Wt.: 13.2 g (0.47 oz.); Engines: single stage - A3-4T (First Flight), A10-3T, first stage - A10-0T, second stage - 1/2A3-4T

BLACK BRANT II™

High flying 1/13 scale model of the Bristol Aerospace sounding rocket used by the Canadian Armament Research and Development Establishment for upper atmospheric research. An ideal first "D" engine powered model.

Specifications:
Length: 63.2 cm (24.875"), Dia.: 33.7 mm (1.325"); Wt.: 152.8 g (5.4 oz.); Engines: D12-5 (First Flight), D12-7

EXPLORER™ SERIES

BULL PUP 12D™
EST 1972
$8.89

HAWKEYE™
EST 0873
$3.99

SENTINEL™
EST 1987
$12.79

BULL PUP 12D™

This is our sport scale version of the U.S. Air Force's AGM-12D Bull Pup. The Bull Pup 12D™ is the perfect first scale model. Its unique appearance will make it stand out on the launch field or while on display.

Specifications:
Length: 39.7 cm (15.625"); Dia.: 33.7 mm (1.325"); Wt.: 50.9 g (1.8 oz.); Engines: A8-3 (First Flight), B4-4, B4-4, B6-4, C6-5

HAWKEYE™

Military surface-to-air missile styling and out-of-sight flights are the trademarks of this fun flier. Features patriotic red, white and blue decor plus great performance.

Specifications:
Length: 21.6 cm (8.5"); Dia.: 13.8 mm (0.544"); Wt.: 11.9 g (0.42 oz.); Engines: 1/2A3-2T (First Flight), A3-4T, A10-3T

SENTINEL™

This big model features air-to-air missile styling and realistic liftoffs. An impressive addition to your fleet and a real crowd-pleaser. Extensive decal sheet makes finishing easy.

Specifications:
Length: 70.2 cm (27.625"); Dia.: 41.6 mm (1.637"); Wt.: 76.4 g (2.7 oz.); Engines: A8-3, B4-4 (First Flight), B6-4, C6-3, C6-5

HELIO*COPTER™
EST 1995
$12.79

MEAN MACHINE™
EST 1295
$20.99

HELIO* COPTER™

With clean lines and decor, this rocket soars high on "C" engines. Then watch eyes open when the nose cone separates and deploys three spring-loaded helicopter blades and begins its slow, spinning descent to the ground!

Specifications:
Length: 64.5 cm (25.4"); Dia.: 34.2 mm (1.346"); Wt.: 81.8 g (2.89 oz.); Engines: C6-3 (First Flight), C6-5

MEAN MACHINE™

Stand back on this one! Over six feet of body tube with a kick-in-the-pants "D" engine to boot. This tall, lean rocket is the perfect first "D" engine model and is a spectacular flier! Requires 5 mm (3/16") diameter Maxi-Rod™ (EST 2244) to launch.

Specifications:
Length: 200 cm (78.75"); Dia.: 41.6 mm (1.637"); Wt.: 164 g (5.8 oz.); Engines: D12-5

EXPLORER™ SERIES

HORNET™
EST 2030
$7.99

This is a great sport rocket with missile-like styling. This model features a unique fin configuration (the fins are die-cut balsa) and is capable of achieving out-of-sight flights. A great second or third model.

Specifications:
Length: 45.1 cm (17.75"); Dia.: 24.8 mm (0.976"); Wt.: 33.1 g (1.17 oz.); Engines: B4-4 (First Flight), A8-3, B6-4, B8-5, C5-3, C6-5

DELTA CLIPPER™
EST 2067
$14.49

Those who love high performance will love this design-optimized, two-stage "D" rocket. This rocket is capable of over 1/2 mile of altitude. And to top it off, this model is constructed tough: thick-walled body tubes, slotted tubes for through-the-wall fin construction, and a plastic nose cone.

Specifications:
Length :66 cm (26"); Dia.: 25.4 mm (1"); Wt.: 73.8 g (2.6 oz.); Engines: Two Stage Configuration: Upper Stage - D12-7; First Stage - D12-0, Single Stage Configuration: D12-5, D12-7

MAGNUM™
EST 2032
$21.99

Powerful two-stager hauls payloads up to 1/4 mile high! Features a "D" engine in the booster section for heavier cargo capability.

Specifications:
Length: 62.5 cm (24.625"); Dia.: 41.6 mm (1.637"); Wt.: 80.1 g (2.83 oz.); Engines: Single Stage - B6-4 (First Flight), A8-3, B4-4, B8-5, C6-5.; Upper Stage - A8-5 (First Flight), B4-6, B6-6, C6-7; First Stage - D12-0

OPTIMA™
EST 2035
$39.99

This massive rocket stands nearly four feet tall and measures over 2.6 inches in diameter! Slow, majestic "D"-powered liftoffs. Includes chrome and metal-flake decal sheets. Requires 5 mm (3/16") Maxi™ Rod (EST 2244) for launch.

Specifications:
Length: 120.7 cm (47.5"); Dia.: 66 mm (2.6"); Wt.: 234.9 g (8.3oz.); Engines: D12-3 (First Flight), D12-5

GREY HAWK™
Orbital Interceptor
EST 2068
$13.99

This is Estes' concept of a futuristic fighter that utilizes hybrid engines for atmospheric flight and a rocket engine for excursions into low earth orbit. Taking off from aircraft carriers, its primary mission is to hunt satellites and other spacecraft. Estes' model version features parachute recovery, a large decal sheet and a unique plastic-molded nose cone.

Specifications:
Length: 42.0cm (16.5"); Dia.: 33.7 mm (1.325); Wt.: 60.5 g (2.1 oz.); Engines: B4-4 (First Flight), A8-3, B6-4, B8-5, C5-3, C6-3, C6-5

SCRAMBLER™
EST 2072
$12.99

Sturdy, reliable sport egg-lofter can haul all kinds of experimental cargo in its big 51 mm (2") diameter payload section. Boosts an egg and returns if un-scrambled!

Specifications:
Length: 55.0 cm (21.5"); Dia.: 51 mm (2.0"); Wt.: 71 g (2.51 oz.); Engines: Without egg - B4-2 (First Flight) B6-2, B8-5, C6-5; With egg - C5-3

Estes

Challenge series

CHALLENGE™ SERIES

SKILL LEVEL 3

When you are ready for a challenge or looking for more power, then it's time to step up to the Challenge™ Series. Here's where you will find models that demand the Estes "E" engine for full flight satisfaction. There is the easy-to-build, highly-affordable Maniac™ that will have you out flying in less than a hour (on "E"s, "D"s, even "C" engines). The Challenge™ Series also features the beautifully detailed model of the SR-71 Blackbird™. Fans of glider rocketry will enjoy the exciting Tomcat™ Swing-Wing Fighter.

Challenge™ Series models involve more time and skill for assembly. They may demand the use of other adhesives such as epoxy or advanced finishing and painting techniques. The construction, finishing and flight of a Challenge™ Series rocket is a proud accomplishment.

 *Unless otherwise specified, all models in this catalog require assembly

ESTES

Model Rocketry Technical Manual

By William Simon Revised 1993 By Thomas Beach and Joyce Gunik

INTRODUCTION

Welcome to the exciting world of Estes model rocketry! This technical manual was written to provide both an easy-to-follow guide for the beginner and a reference for the experienced rocket enthusiast. Here you'll find the answers to the questions most commonly asked. More complete technical information on all the subjects can be found in the many publications listed in your Estes catalog.

TABLE OF CONTENTS

WHY ESTES MODEL ROCKETRY?

The hobby of model rocketry originated at the dawn of the space age in the late 1950's. Seeing space boosters carry the first artificial satellites into Earth's orbit inspired many enthusiastic young people to try to emulate the rocket pioneers by building their own rockets. Unfortunately, these homemade "rockets" usually involved stuffing flammable chemicals into metal pipes, very often with tragic results. Newspapers told of fingers and eyes lost -- and all too frequently of lives lost. What was needed was a safe alternative that would allow young people to experience the thrill of constructing and launching their own rockets and provide them with the opportunity to explore the fascinating science of rocketry. Estes model rocketry is the answer.

A SAFE PROGRAM

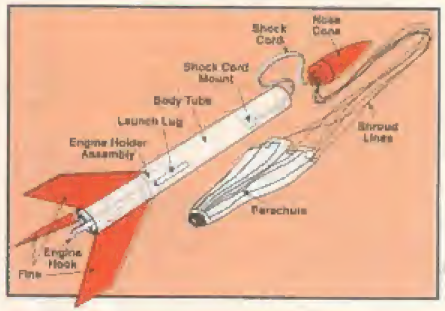
Estes model rocketry is a safe activity because it incorporates three important features. The first is the model rocket engine, a professionally manufactured, low cost, solid-fuel rocket engine. This frees the rocket builder from the inherently dangerous procedures of mixing chemicals and packing propellant.

The second feature is the use of safe materials for constructing the rockets. All model rockets are built using only lightweight materials such as paper, plastic, and wood. Metal parts are never used for the main structural components of the model.

The third feature is the incorporation of the Model Rocket Safety Code into all our flying activities. The safety code provides guidelines for the safe operation of model rockets, such as launching the rockets electrically from a safe distance, and using recovery systems to gently return the model to Earth. When the safety code is followed, model rocketry is an extremely safe activity, safer than baseball, soccer, or swimming. Our hobby's excellent safety record spans over 35 years and 300 million rocket launches.

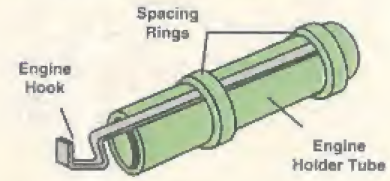
YOUR FIRST MODEL ROCKET

The Estes Alpha is shown here to illustrate the parts of a typical model rocket for the beginning rocket builder. The construction techniques used in this and other model rockets are explained in greater detail in this manual.



For your first model rocket we recommend one of the Estes E2X series. No modeling experience is needed to build an E2X model. Construction involves almost no cutting or sanding, and the models do not need painting.

The Beta series of models is an excellent choice for your second or third model. The Beta models are also a good starting point if you have previous model building experience.



As your knowledge of rocketry and your modeling skills increase you can move up to the Explorer, Challenge, Master, and Pro series models, and eventually to building your own custom designs from parts available in the Estes catalog.

CONSTRUCTION TECHNIQUES

In the construction of your Estes model rockets you will typically need the following tools and supplies (see kit instructions for specific requirements).

- Modeling knife
- Scissors
- Ruler
- Spray paint
- Balsa sealer or filler
- Masking tape
- Tube-type plastic cement
- White glue
- Fine and extra fine sandpaper

Always exercise care when using a modeling knife (they are very sharp!) and don't leave the knife laying around after you finish with it. Use some sort of cutting board under the knife. A smooth, flat piece of board is great; an old phone book or thick catalog also works well on a hard surface. Use newspaper to protect your work surface from accidental glue spills.

TYPES OF GLUE

Several types of glues and adhesives are commonly used in the construction of model rockets; the proper glue to use depends on the application.

1. White Glue: This glue works on porous materials such as paper and balsa. It is a good choice for engine mounts, balsa and fiber fins, launch lugs, paper parts, and for applying fillets to fin-body joints.
2. Aliphatic Glue: Also known as "wood glue" or "carpenter's glue"; it is usually yellow or tan in color. It is used just like white glue, but it is stronger and dries faster.
3. Tube-type Plastic Cement: This thick, clear liquid is used to glue styrene plastic parts to porous materials such as paper. It is typically used to glue plastic parts to body tubes. Some E2X series kits use this glue for assembly.
4. Liquid Styrene Cement: This thin, clear liquid is used to bond styrene parts together. The cement comes in a bottle and is applied with a small brush.
5. Cyanoacrylate: Commonly known as "super" or "instant" glues, these adhesives are available in both thin and thick formulations. Because this type of glue can instantly bond skin, it should never be used by unsupervised children. Eye protection and gloves are recommended. These adhesives are useful for quick assembly or field repairs. They work well for gluing plastic parts to balsa or body tubes.
6. Epoxies: These two-part adhesives are also recommended for the advanced modeler. Epoxy provides extra strength for the engine mounts and fins of high-thrust Pro Series kits. It also makes excellent fin fillets in one step.

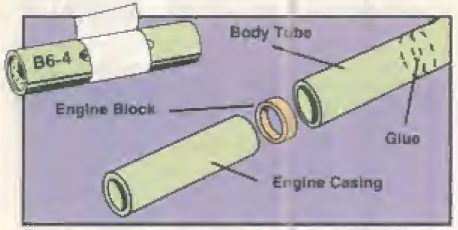
1. ENGINE MOUNTING METHODS

It is important to have a strong engine mount. This secures the engine, allowing it to "push"your rocket into the air.

Engine Block Installation

Some models use an engine block to keep the engine from traveling too far forward in the rocket body when the rocket is launched.

When building a model, use an engine casing (or the special spacer tube supplied in some kits) to push the engine block into position. First, mark the engine casing 1/4 inch from the end. Apply glue to the inside of the tube using a cotton swab or small dowel. Place the engine block just inside the rear of the body tube, then push the block forward into position with the engine casing in one smooth motion so the glue will not freeze the block in the wrong place. When the mark on the engine casing is even with the rear of the body tube the block will then be in the correct position. Remove the engine casing immediately



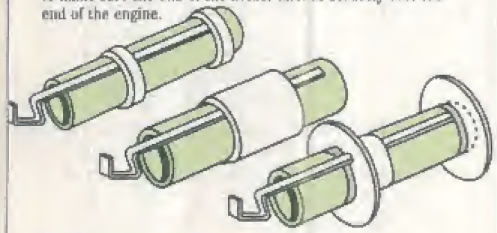
When mounting the engine in a model with an engine block, wrap the engine with masking tape until it makes a tight friction fit in the tube, then slide the engine into place. If the fit is too loose, the engine will kick out at ejection and may not deploy the recovery system. If the fit is too tight, you may damage the model trying to push the engine in place. Adjust the amount of tape as needed.

If the arrangement of the engine mount tube and fins allows enough space, a wrap of tape around the tube and engine joint can help hold the engine in the model.

Engine Holders

In many models a quick release engine holder (also called an engine hook) is the best device to use for mounting an engine. The forward end of the engine holder is inserted through a 1/8 inch wide slit in the tube, and prevents forward movement of the engine. Apply glue fillets where the engine mount spacer rings attach to the engine mount tube for extra strength.

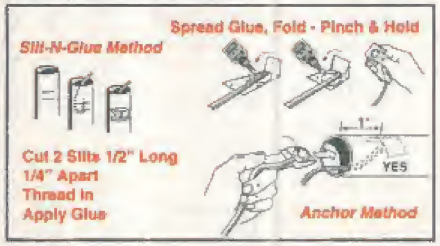
To mount an engine in a model with an engine holder, spring the end of the holder up and slide the engine into place. Check to make sure the end of the holder latches securely over the end of the engine.



2. SHOCK CORD MOUNTS

Attach the shock cord securely. Both methods shown yield good results. The slit-n-glue method is good for body tubes too small for an anchor mount.

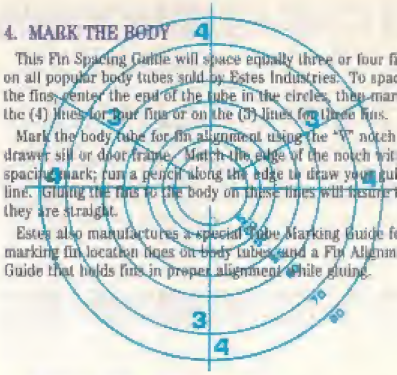
The anchor is cut from paper or index card stock. Be sure to glue the anchor far enough into the tube or it will interfere with the proper fit of the nose cone.



3. SECURING A SCREW EYE

If your model uses a screw eye to attach the shock cord to a balsa nose cone or adapter, make sure the screw eye is securely attached. Make a hole by inserting and removing the eye; then squirt glue into the hole and replace the eye.

4. MARK THE BODY



This Fin Spacing Guide will space equally three or four fins on all popular body tubes sold by Estes Industries. To space the fins, center the end of the tube in the circles, then mark at the (4) lines for four fins or on the (3) lines for three fins.

Mark the body tube for fin alignment using the "V" notch of a drawer slit or door frame. Match the edge of the notch with a spacing mark; run a pencil along the edge to draw your guide line. Gluing the fins to the body on these lines will insure that they are straight.

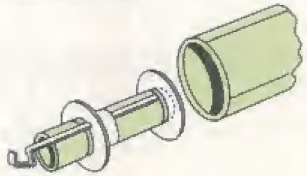
Estes also manufactures a special Tube Marking Guide for marking fin location lines on body tubes, and a Fin Alignment Guide that holds fins in proper alignment while gluing.

5. INSTALL THE ENGINE MOUNT

Be sure the glue on the engine mount rings is completely dry before you install the mount in the body tube. The fin alignment lines should be drawn on the body before installing the engine mount. You will position the mount so the engine holder is midway between two fin lines for easier operation.

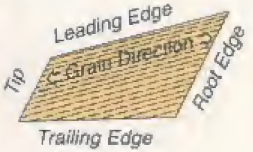
Before gluing, make sure the mount slides easily in the body tube. If it's tight, sand it until it slides easily.

Smear a liberal amount of glue around the inside of the body over the area where the mount's ring or coupler will fit. Insert the mount into position in one smooth motion. DON'T pause, or the glue will "grab" it in the wrong place! Support the tube "nose-up" while the glue dries.



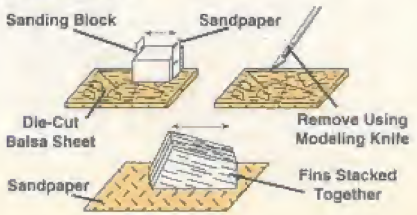
6. BALSA FINS

Fins are used to aerodynamically guide your rocket. Some model rockets use fins made from thin sheets of balsa wood. In many kits the fins are pre-cut for you by a punch die. In other kits, or to make custom fins, you must use a pattern to mark and cut a blank sheet of balsa. All balsa fins must be cut so that the grain of the wood runs parallel with the leading edge of the fin for maximum strength.



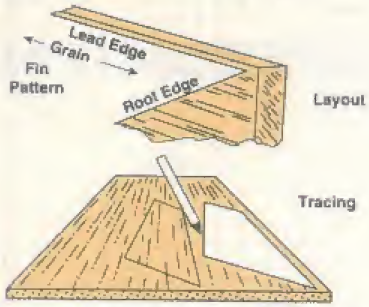
Die-Cut Balsa Fins

Before removing the die-cut fins from their sheet, use extra fine sandpaper to sand both surfaces of the sheet of balsa (a sanding block is helpful here). Use a modeling knife to carefully cut through the points where the fins are still attached to the die-cut sheet, then remove the fins. Stack the fins together and sand all edges square.

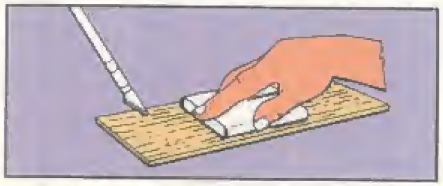


Balsa Fins From Patterns

To make fins from an un-cut sheet of balsa, start with a full-size fin pattern cut from stiff paper or thin cardboard. When laying out the fins on the sheet of balsa be sure to position the pattern so that the leading edge of the fin runs parallel to the grain direction! Trace around the pattern with a pencil or ball point pen to mark the balsa for each fin.



Use a metal straightedge whenever possible. Hold the knife blade at a 90° angle to surface being cut, and handle at about 45° for clean cut. If blade is dull or held too high, balsa tends to tear. A razor saw blade may be required to cut thicker balsa.



Shaping Balsa Fins

The instruction sheets in many kits tell you to sand all edges of the fins square. This is fine, and it is the easiest method, but you can reduce drag and increase the altitude performance of your rocket by proper shaping of the fin edges.

For general purposes, sand all fin edges round except the root edge (the edge that glues to the body). Make the root edges straight and square, never rounded! The sides of the fins should be sanded smooth.

On high performance models sand the fins to the streamlined shape shown for minimum drag. The front (leading) edge of the fin should be rounded; the back (trailing) edge should come to a sharp edge.

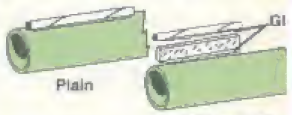
7. ATTACHING THE FINS

After marking the tube and sanding the fins, you are ready to attach them to the body. The best way to attach balsa or fiber fins to a rocket with white glue is by using a "double glue joint". Apply a layer of glue to the root edge of a fin and a thin layer of glue to the body tube where the fin will be attached. Do this for all fins and allow this glue to dry. Then apply a second line of glue to the root edge and press the fin in place onto the body, holding it in place until the glue begins to set. Before the glue sets completely, sight down along the body tube to make sure that the fin is aligned parallel with the tube, and oriented straight away from the surface of the tube. Adjust the fin alignment as needed. Support the rocket body in a vertical position while the glue on the fins dries.

Sometime after the fin joints have dried completely, they should be reinforced. Do this by applying a "fillet" of glue as shown. Always support the body in a horizontal position while fillets are drying so that the glue does not run. Build up the fillets in several thin layers, allowing each layer to dry between applications (this is much faster than waiting for a single thick fillet layer to dry).

8. ATTACHING LAUNCH LUGS

The launch lugs are used to position the rocket on the launch rod. The lugs and rod help guide the rocket in its first few feet of flight. The model must be guided until it is going fast enough for the fins to guide it. Launch lugs are attached in much the same way as fins. If a stand-off is used to keep the rod from hitting a large diameter payload section, attach the lug to the stand-off piece first, then attach the unit to the body. Sight along the tube to be sure the lug is parallel to the body tube before the glue sets. Apply glue fillets to the lug after the initial glue joint has dried.



9. PARACHUTE ASSEMBLY

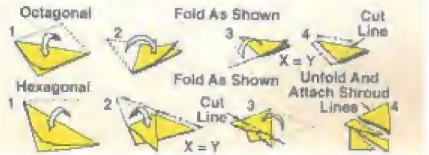
The most common model rocket recovery system is the parachute. On page 9 you will find alternate recovery systems. To assemble an Estes parachute, cut out the plastic parachute along the dotted lines. Apply the six vinyl tape rings to the corners of the parachute and punch holes through the parachute material in the center of the tape rings using a sharp pencil. Cut three equal length shroud lines that are twice as long as the parachute diameter. Tie both ends of the shroud lines through the holes in the tape rings, as shown.

To attach the parachute to the nose cone or adapter eyelet, thread the shroud lines through the eyelet, pass the parachute through the loop of shroud lines as shown, then pull the lines tight.

In addition to regular, pre-printed model rocket parachutes, you can assemble custom parachutes using a wide variety of thin plastic sheeting. When making a chute from scratch, cut the plastic sheet to shape, then attach shroud lines as shown previously. Carpet thread makes excellent shroud lines.

Parachute Shape

The most common parachute shapes are square, round, hexagonal and octagonal. While square parachutes are the easiest to make, they are not very efficient and allow a considerable amount of sway during descent. Round parachutes are very stable in descent, but are more difficult to make. Hexagonal and octagonal parachutes are stable and reasonably easy to make. The accompanying drawings illustrate methods for making these shapes.

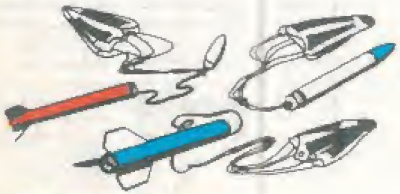


Snap Swivel Assembly

It's often worthwhile to attach your parachute to a snap swivel to allow the 'chute to be easily removed. This lets you change parachute size in response to different wind conditions, or swap 'chutes between models. A snap swivel has an eyelet on one end and a wire snap hook on the other. The swivel connection in between helps keep your parachute lines from tangling up if the 'chute rotates on descent. Snap swivels are available from Estes or where fishing supplies are sold.

10. CONNECT IT TOGETHER

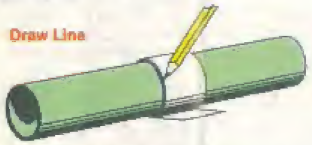
The first illustration shows how nose cone, parachute and rocket are connected on most models. If the rocket has a heavy payload section, it's a good idea to use two chutes as shown in the second picture.



11. CUTTING TUBES

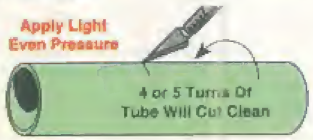
When building custom design rockets or replacing damaged tubes on your models, you will often need to cut a specific length body tube. Here's how to get a neat cut every time.

(1) Mark the tube at the point where the cut is to be made. Wrap a straight strip of paper around the tube and align the edge with the mark. Draw a line completely around the tube. You can also use the pencil holder on the Estes Tube Marking Guide to draw the line.



(2) Slide a stage coupler or expended engine casing into the tube – center it under the cut position to support the tube.

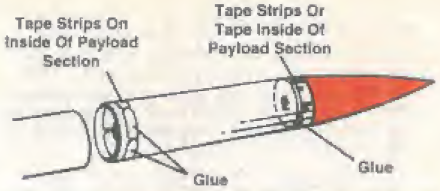
(3) Using a sharp blade, cut lightly along the line, rotating the tube as you cut. Don't try to cut all the way through on the first turn. Use a light pressure on the knife for several turns until you cut through.



(4) Slide the stage coupler into the cut end of the tube. Hold the tube near the cut end and work it over a flat sheet of very fine sandpaper, with a circular motion as shown, to remove burrs and rough edges.

12. CLEAR PAYLOAD SECTIONS

Models that have a clear plastic payload section present a special problem: White glue will not bond the plastic to a balsa nose block. To overcome this, apply tape strips to the inside of the payload tube, then glue the balsa nose block to the tape strips using white glue.



FINISHING

The finish of a rocket starts with the very first steps of assembly. Sloppy gluing and other messy habits will ruin the appearance of a rocket so that nothing can be done to get the perfect appearance which is desired. On the other hand, careful construction will make a model look good even before the paint is applied. A model with a smooth finish not only looks more professional, it expeiences less drag in flight, so it flies higher.

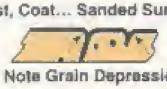
The degree of difficulty in finishing a model rocket depends on the materials used in its construction. Models with plastic nose cones and fins are the easiest to finish (some come with all pre-colored parts and require no finishing at all). Models built with balsa parts require extra steps to produce a smooth, shiny finish.

1. SANDING AND SEALING BALSA PARTS

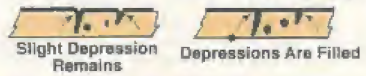
To get a smooth finish, the wood grain of the balsa must be filled. Many suitable types of sanding sealers and wood fillers are available at hobby shops and hardware stores. Many sanding sealers give off harmful fumes and must be used only in well-ventilated areas. Water-based wood fillers have no noxious fumes; you may need to add water to thin them to a brushable consistency.

Paint cannot replace sandpaper. If a balsa surface is not sanded and sealed carefully, it will be impossible to get a smooth paint job. Begin by sanding all balsa surfaces with extra-fine sandpaper until smooth.

Next, apply a coat of sanding sealer to the balsa. Let this dry completely, then sand with 320 grit (or finer) sandpaper, until the surface is smooth again. Apply more sealer, repeating the procedure until all the pores in the balsa are filled.



Practically all of the sealer should be sanded off after each coat. This is because the purpose of the sealer is to fill in the holes, not the smooth areas of the balsa.



2. SPRAY PAINTING THE MODEL

Using a good enamel spray paint is the easiest way for a novice to get a smooth, uniform finish on a model rocket. Other types of paints can be used, but be wary of mixing different types of paint on the same model; paint compatibility problems may cause the model's finish to wrinkle or "craze". If in doubt, test the compatibility of different paints on a piece of scrap material. Paint fumes can be harmful; only paint outdoors or in a well-ventilated area.

To hold the model during painting, make a "painting wand" by rolling a sheet of newspaper into a very long, narrow cone and inserting it into the rocket's engine mount. An expended engine casing glued onto a wooden dowel also makes a great painting wand, especially for heavier models. Before painting, wipe the model with a clean, slightly damp cloth to remove any dust from its surface.

3. PRIMER COAT (Optional)

While not necessary, a coat of sandable primer provides a uniform base color and a better bonding surface for the paint layers; it also helps fill any remaining minor surface imperfections. Spray on the primer in thin coats until the model is a uniform color. When the primer is completely dry, lightly sand the surface with 400 grit (or finer) sandpaper.

4. BASE COLOR

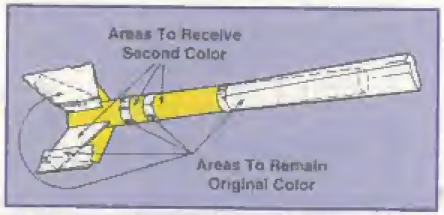
The base color is the lightest of the colors to be used on the model. Usually this will be white. If the model is to be painted with fluorescent colors, the base coat must be white.

Always spray on the paint in light, even coats, allowing the model to dry between each coat. Trying to cover the model with one thick coat of paint will only result in paint runs. Several thin coats will also dry faster than a single thick coat. When the first coat has dried completely, sand lightly with extremely fine sandpaper. Wipe off any dust and apply another coat. Let this dry, then follow with additional light coats until the model has a clear, pure color.

Let the base coat dry completely in a warm, dust-free area. Allow the model to dry a full day if it is to be masked for additional colors.

5. THE SECOND COLOR

When the base color has dried completely, cover all areas on the model which are to remain this color. Cover small areas with masking tape. Large areas should be covered with typing paper, held down at the edges with masking tape. It's important to seal the tape down tightly along the edge. Masking tape that is too sticky may pull up the base color paint when removed; if you have this problem, you can stick the tape to you skin before applying it to the model to remove some of its tackiness.

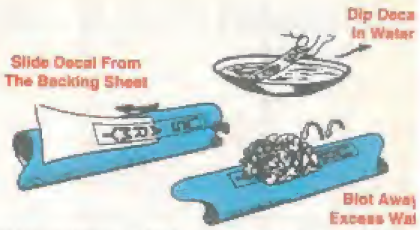


With the model masked, apply an additional thin coat of the first color to finish sealing the edges of the tape. When this is dry, apply the second color in several thin coats. Use just enough paint to get good color. After the last coat is dry, remove the masking carefully to avoid peeling the paint. A third color would be applied in the same way as the second.

6. FINAL TOUCHES

For best results, let the paint dry overnight before applying decals. Some models have self adhesive decals; these must be positioned very carefully before pressing into place, since they can not be moved once they are stuck down.

To apply a water transferable decal, first cut it out of the decal sheet, then soak it in lukewarm water for 60 seconds or until it begins to slide on the backing sheet. Slide the decal so that one edge is off the backing. Position this edge on the model and hold it in place while pulling the backing out from under. Smooth the decal down with a damp finger, then blot away any excess water with a rag or paper towel.



After the decals have dried completely, spray the model with clear acrylic coating to protect the finish. Apply the clear spray in several thin coats, allowing time for each coat to dry. If the model was finished with fluorescent paint, apply a light coat of clear spray before applying decals.

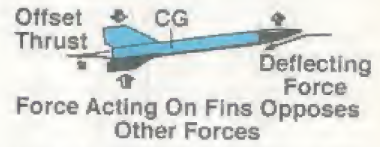
STABILITY

One of the first things a model rocket designer learns is that a vehicle will not fly unless it is aerodynamically stable. By stable we mean that it will tend to keep its nose pointed in the same direction throughout its upward flight. Good aerodynamic stability will keep the rocket on a true flight path even though some force (such as an off-center engine) tries to turn the model off course.

If a model is not stable, it will constantly turn its nose away from the intended flight path. As a result it will try to go all over the sky, but end up going "nowhere." An unstable rocket will usually tumble to earth after the engine burns out, damaging the model.

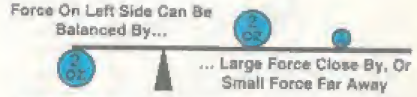
When a free-flying object rotates, it always rotates around its balance point. The proper term for the balance point is the center of gravity, abbreviated as CG. Thus the balance point (CG) is the pivot for all forces trying to turn the rocket.

The most significant forces acting on a model rocket in flight are caused by the thrust of the engine, the action of air on the nose and the action of air on the fins. Off-center thrust and forces on the nose try to bring the nose of the rocket around to the rear. They are opposed by the forces acting on the fins. All these forces are amplified by the distance from the location of the force to the center of gravity.

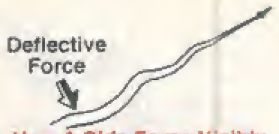


Force Acting On Fins Opposes Other Forces

As long as the forces on the fins of the rocket are great enough to counteract the forces on the nose and any off-center thrust, the rocket will fly straight. If the fins are too small and/or too close to the center of gravity, there will not be enough force to counteract the force on the nose. As a result, the nose will swing out to the side and the model will try to chase itself around the sky.



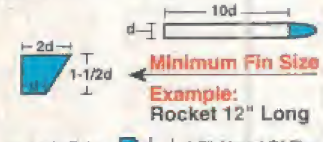
The side forces on the nose and fins of a rocket that is flying straight are very small. When something disturbs the rocket and it starts to rotate sideways, the side forces on both nose and fins increase. (There is some aerodynamic force on the body; however, it is small and can usually be ignored.) Depending on the size and shape of the nose and fins and their distances to the center of gravity, one will overpower the other and force the rocket to turn its way. If the nose overpowers the fins, it's too bad. However, if the fins overpower the nose, the rocket will swing back into line and continue on its way.



How A Side Force Visibly Affects Course Of Normally Stable Rocket

Although determining the exact relationships between various forces on a model rocket requires higher mathematics, certain practical rules can be used by even the beginning rocket modeler to design stable rockets. The first rule is to use a long body. Until you have considerable experience in designing models, the length of the body tube used should be at least 10 times its diameter. This makes it easier to get enough distance between the center of gravity and the fins.

The second rule is to make the fins large. The larger the fins, the more force they will produce when the rocket starts to turn. For the first few designs, use a fin which is at least as large as the example in the illustration.



The third rule is to place the fins as far back on the rocket as possible. Generally, this means that the rear edge of the fin will meet the rear end of the body and the fin will be swept back. Do not place any fins ahead of the center of gravity!

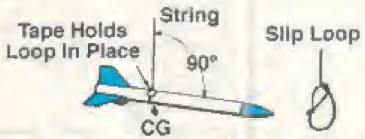
Finally, the rocket should balance at least 1/8 its length ahead of the front of the fins. This gives the fins the leverage they will need to counteract the force on the nose.

Remember that these rules are general; they are based on experience rather than precise mathematical analysis. Always remember to test your model for stability before you launch it.

SWING TESTING FOR STABILITY

The easiest way to test the stability of a model is to fly it – without launching it. Do this by attaching a string to the model and swinging it through the air. If the string is attached at the rocket's CG, its behavior as it is swung through the air will indicate what it will do in powered flight.

Test your model by forming a loop in the end of a six to ten foot long string. Install an engine in the rocket; use the heaviest engine you expect to fly in the model. (The center of gravity is always determined with an engine in place.) Slide the loop to the proper position around the rocket so the model balances horizontally. Apply a small piece of tape to hold the string in place.



With the rocket suspended at its center of gravity, swing it overhead in a circular path. If the rocket is very stable, it will point forward into the wind created by its own motion. Some rockets which are stable will not point forward of their own accord unless they are started straight. This is done by holding the rocket in one hand with the arm extended and then pivoting the entire body as the rocket is started in the circular path. It may take several attempts before a good start is achieved.

If it is necessary to hold the rocket to start it, an additional test should be made to determine when the model is stable enough to fly. Move the loop back on the body until the tube points down at a 10° angle below the horizontal. Repeat the swing test. If the model will keep its nose pointed ahead once started, it should be stable enough to launch.

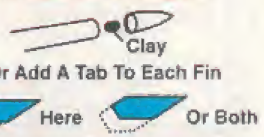
Double Check A Rocket With Questionable Stability As Follows:

Be careful when swinging a rocket overhead: A collision with a nearby object or person could be serious. Always do your testing in an open, uncluttered area.

Don't try to fly a rocket that has not passed the test. Most unstable rockets loop around in the air harmlessly. However, a few marginally unstable models will make a couple of loops and then become stable due to a CG shift as the propellant burns. When this happens, the model can crash into the ground at high speed.

If your rocket does not pass the stability test, it can usually be made stable. Two methods can be used: The balance point can be moved forward, or the fin area can be enlarged. To move the balance point forward, add weight to the nose cone. For models with hollow plastic nose cones, pack some clay into the tip of the nose. To add weight to balsa nose cones, attach washers to the base of the cone. The CG can also be moved forward by adding a payload section to the model. Fins can either be replaced with larger ones or extra tabs can be glued to the rear or tip edges of the fins. Additional fins could also be added to the model. Some scale models use supplementary clear plastic fins. After making your changes, swing test the model again to be sure it is now stable.

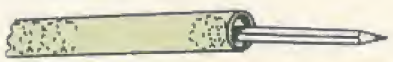
Add A Nose Cone Weight...



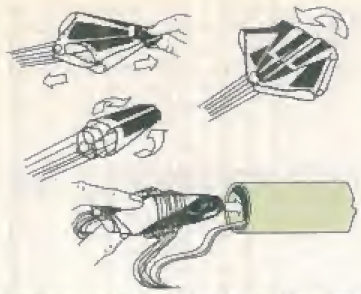
PREPARING FOR FLIGHT

Parachutes and streamers must be protected from the heat of the ejection charge by using flame-resistant recovery wadding. NEVER use regular tissue paper in place of flame-resistant wadding! Ordinary tissue paper will continue to smolder after ejection and can cause dangerous grass fires.

Loosely pack enough flame-resistant recovery wadding into the tube to fill it for a depth of at least twice the body diameter. The wadding should fit against the side of the tube all the way around to give a good seal.



To fold the parachute, hold it between two fingers at its center and pass the other hand down it to form a "spike" shape. Fold this spike into several sections as shown. Pack shroud lines and shock cord in on top of the wadding. Push the folded 'chute down into the tube on top of the shroud lines and shock cord, then slide the nose cone into place.



If the parachute has been packed in the model for an extended period, re-pack the 'chute just prior to launch. Dusting the parachute with talcum powder before packing will also increase the chances of a successful deployment. It is especially important to follow these precautions on cold days because the low temperature makes the plastic parachute material less flexible.

Check the fit of the nose cone on the model: If it is too tight, see if the shock cord or shroud lines were trapped between the nose cone shoulder and the body tube. If the nose is still too tight, sand the shoulder of the nose cone or the inside of the body tube with fine sandpaper. If the nose cone fit is too loose, wrap tape on the shoulder to adjust the fit. The nose cone should separate easily, but should not fall off if the rocket is inverted.

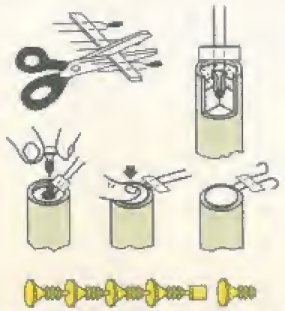
To deploy the streamer or parachute recovery gear correctly, the engine MUST be held in place SECURELY. This may be done by wrapping the engine with tape until it makes a snug fit in the body tube or engine mount.

On models using engine holders, make sure the end of the holder latches securely over the end of the engine.

IGNITER INSTALLATION

For safety reasons, do not install igniters in model rocket engines until you are ready to fly the rocket. Never connect a launch control system to an igniter installed in a rocket engine unless the model is on a launch pad. Never ignite a rocket engine indoors.

Use scissors to separate the igniters; leave the paper strip attached to the igniter wires. Hold the engine nozzle end up, then insert the igniter into the nozzle as far as it will go. To operate properly, the tip of the igniter MUST touch the propellant. Insert the igniter plug into the nozzle and firmly push it all the way in. Be sure to use the correct color-coded igniter plug for the engine to insure proper fit. Bend the ends of the igniter wires back; this provides a larger area for attaching the micro-clips.



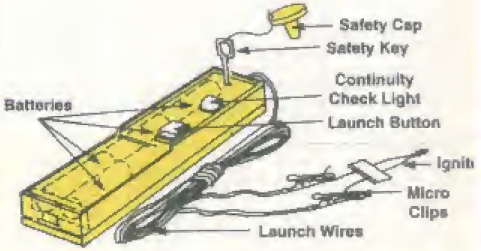
If an igniter plug is not available, roll a 1" square of flame-proof recovery wadding into a ball and insert it into the nozzle alongside the igniter wires using the point of a pen or pencil. Press the wadding ball firmly in place.

LAUNCHING

Model rockets, like professional rockets, are launched electrically. This provides both safety and realism. Each engine sold by Estes Industries is supplied with an igniter, igniter plug, and complete instructions; still more information is supplied with launcher kits. However, the basic information needed to launch models successfully is included in these pages.

1 LAUNCH CONTROL SYSTEMS

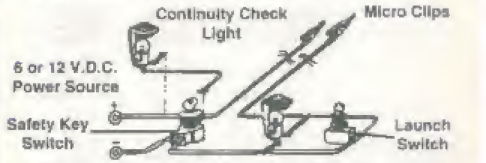
The electrical launch system controls the flow of electrical current to the igniter. Safety features built into the controller insure that current does not reach the igniter until it is time to launch. An Estes launch controller is shown below:



All launch control systems work by passing electrical current through the high-resistance wire in the tip of the igniter; this current heats the wire, which ignites the coating on the igniter, which in turn ignites the engine. The launch system is attached to the igniter with micro-clips, one clip on each igniter wire. When connecting the micro-clips to the igniter, make sure the clips do not touch each other or the rod or blast deflector. If they do touch, the current from the battery will "short" through the clips, rod, or deflector and not reach the igniter. Micro-clips become corroded with use; use sandpaper to clean the inside of the clip jaws to insure good electrical contact.

All launch control systems must have a spring return launch button so the current turns off automatically when the button is released. In addition, a removable safety interlock ("safety key") must be provided; this could be an electrical key-switch or an insertable metal pin. When the safety key is removed, the launch controller cannot complete the electrical circuit to send current to the igniter. **ALWAYS remove the safety key and carry it with you when you go hook up the igniter!** This insures that no one could activate the launch controller while your hands are near the rocket nozzle.

Any homemade electrical launch control system must include all the safety features outlined above. See the Estes publication "Model Rocket Launch Systems" for more details. A typical launch controller circuit is shown below:

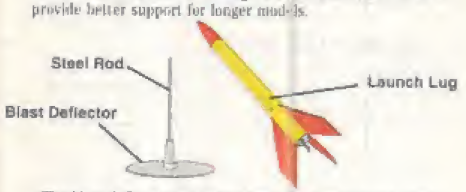


This circuit includes a continuity check light. This is a small bulb (no more than 1/4 amp for safety) that lights when a complete circuit exists between battery and igniter; this indicates that the rocket can be launched. If the continuity check bulb does not light when the safety interlock is closed, check to see if the micro-clips are properly connected to the igniter (always remove the safety key before checking the igniter!).

2. LAUNCHER DESIGN

A model rocket cannot be simply set on its fins and launched since the rocket requires a fast airflow over its fins for stability. The model must be guided until it is moving fast enough for the fins to operate; the launcher provides this initial guidance.

Most model rockets are guided during launch by an 1/8" diameter, 32" long launch rod (heavier models require thicker rods for extra strength). A short tube, called the launch lug, is glued to the side of the rocket. This tube slips easily over the rod and keeps the rocket pointed in the right direction during launch. A single launch lug should be mounted near the balance point of the rocket; two lugs located either side of the CG provide better support for longer models.



The blast deflector is a metal plate that prevents the engine exhaust from hitting the launch pad or ground, preventing fires. Heavier rockets will require thicker launch rods and a launcher with a heavier base. Bricks or rocks can be used to weight the base when extra-large models are being launched.

When building a launch pad be sure to use a base that is big enough and heavy enough to provide a secure foundation. A piece of 3/4" plywood a foot square works well for most rockets; a larger base made from two-by-fours easily handles one pound models.

3. LAUNCH SAFETY

Only launch model rockets from a large open area. Make sure the ground around the launcher is clear and has no dry weeds or highly flammable materials. For maximum safety, tie the launch controller safety key to the plastic launch rod cap supplied with the launcher. Always carry the cap and key with you to the launch pad! After sliding the rocket onto the launch rod, place the cap on the rod before hooking up the igniter. The cap protects you from accidental eye injury from the rod. If the cap is not available, put your hand on the end of the rod before leaning over.

Immediately before launching a rocket, check for low-flying aircraft. If there are other people in the launch area, announce the launch loudly to get their attention, followed by an audible five-second countdown.

After a successful launch, remember to remove the safety key from the controller. If the rocket becomes entangled in a power line or other dangerous place, DO NOT attempt to retrieve the model!

4. LAUNCH AREAS

Choose a large field away from power lines, tall trees, and low-flying aircraft. The length of the smallest side of the field should be at least one fourth of the rocket's expected maximum altitude. The Model Rocket Safety Code contains a table of minimum field dimensions for each engine size.

COUNTDOWN CHECKLIST

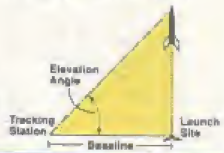
Use a countdown check list when you launch your models. You'll find it makes your rocket flights more successful and enjoyable. The following procedure is recommended for most parachute or streamer models. For other types of rockets, try to develop your own complete check list.

12) Pack flame-resistant recovery wadding into the body tube. Insert the parachute or streamer.
11) Install the nose cone or payload section, checking for proper fit. Check condition of the payload (if any).
10) Apply enough masking tape to the engine(s) for a tight friction fit in the body tube (if required for this model). When launching a multi-stage rocket be sure that the engines are in their proper relative positions and that a layer of cellophane tape is wrapped tightly around each engine joint. Mount the engine(s) in the rocket. If the rocket uses engine holders, check that the holder proper hooks the rear end of the engine.
9) Install an igniter in each engine.
8) Be certain the safety key is not in the launch controller! Place the rocket on the launcher. Clean and attach the micro-clips.
7) Clear the area, check for low flying aircraft, alert the recovery crew, trackers, and spectators.
6) Insert the safety key into the launch controller. Give an audible count down:
5) 4) 3) 2) 1) LAUNCH!

TRACKING

The easiest way to measure how high a rocket flies is to visually "track" the model using a tracking instrument, then "triangulation" is used to determine the altitude. The tracking instrument is used to measure the angle between the ground and the line of sight to the rocket at its peak altitude.

This angle is called the "elevation" angle. When the elevation angle and the distance from tracker to launcher are known, it is very easy to determine the altitude.



TRACKERS

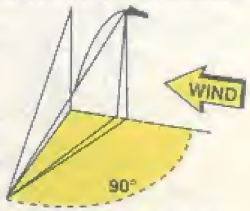
The Estes Altitrak is one of the best all-around basic tracking devices. However, it is easy to construct a simple tracker. A plastic protractor is attached to a ruler as shown. Tie a weighted string through the small hole at the "center" of the protractor. When sighting along the edge of the ruler toward the horizon, the string should hang by the 0 mark on the protractor; when sighting at a point in the sky, the position of the string will indicate the elevation angle.

The distance from the launch area to the tracking station should be approximately equal to the altitude expected for an average rocket flight to be tracked. This distance is called the "baseline" and its length should be carefully measured. The tracker should have a clear view of the launch area and should not be looking into the sun.

Before launch, alert the person at the tracking station. When the tracker signals readiness, the rocket can be launched. The tracker sights along the tracking instrument and follows the rocket as it rises. When the rocket reaches its peak altitude, the tracker "locks" the tracking instrument. An Altitrak is locked by releasing the trigger. To lock the homemade tracker, the operator uses a finger to clamp the string in place before moving the instrument (this takes practice!). The elevation angle is then read from the tracker.

Find the tangent of the elevation angle from the table at the end of this section, or using a scientific calculator (enter the angle, then press the TAN key). Multiply this tangent by the baseline length (the distance from the tracker to launcher) to find the rocket's altitude. The Altitrak gives a direct readout of the altitude, assuming the tracker is located 150 meters from the launch pad.

A single tracker gives best results on calm days. Wind interferes with accuracy since models tend to tilt over into the wind as they fly. The result is that the rocket will not be straight over the launch site at peak altitude, but instead will be some distance over in the direction of the wind. To keep error due to wind drift to a minimum, locate the tracker at a 90° angle to the wind direction as shown.



For better accuracy, use two tracking stations on opposite sides of the launch pad, or place more than one tracker at each station. The easiest way of calculating rocket height using multiple trackers is to find the altitude for each tracker and then take the average of these altitude figures. More complete information on basic altitude tracking is contained in Estes Industries Technical Report TR-3.

TABLE OF TANGENTS

Angle	Tan	Angle	Tan	Angle	Tan	Angle	Tan	Angle	Tan
1	.02	17	.31	33	.65	49	1.15	65	2.14
2	.03	18	.32	34	.67	50	1.19	66	2.25
3	.05	19	.34	35	.70	51	1.23	67	2.36
4	.07	20	.36	36	.73	52	1.28	68	2.48
5	.09	21	.38	37	.75	53	1.33	69	2.61
6	.11	22	.40	38	.78	54	1.38	70	2.75
7	.12	23	.42	39	.81	55	1.43	71	2.90
8	.14	24	.45	40	.84	56	1.48	72	3.08
9	.16	25	.47	41	.87	57	1.54	73	3.27
10	.18	26	.49	42	.90	58	1.60	74	3.49
11	.19	27	.51	43	.93	59	1.66	75	3.73
12	.21	28	.53	44	.97	60	1.73	76	4.01
13	.23	29	.55	45	1.00	61	1.80	77	4.33
14	.25	30	.58	46	1.04	62	1.88	78	4.70
15	.27	31	.60	47	1.07	63	1.96	79	5.14
16	.29	32	.62	48	1.11	64	2.05	80	5.67

RECOVERY SYSTEMS

The recovery system is one of the most important parts of a model rocket. It is designed to provide a safe means of returning the rocket and its payload to earth without damaging or presenting a hazard to persons on the ground. Also, the recovery system provides an area for competition when rocket flyers hold contests to see whose rocket can remain aloft the longest. In addition, rocket recovery is an area for valuable experimentation and research as modelers develop new and better methods of returning their rockets to earth.

Most recovery systems in use today depend on drag (or wind resistance) to slow the rocket. Each changes the model from a streamlined object to one which the air can "catch against" and retard its descent. Six main recovery methods are used by model rocketeers today:

1. Featherweight Recovery, 2. Streamer Recovery, 3. Tumble Recovery, 4. Parachute Recovery, 5. Helicopter Recovery, 6. Glide Recovery.

Some of the most common errors causing recovery system failures are listed below with their solution.

PROBLEM (1) Engine not held securely and ejects, instead of recovery device being deployed.

SOLUTION: On models with engine holder hooks, make sure hook latches properly over end of engine. If engine is held by friction fit, wrap enough masking tape around engine to hold it tightly.

PROBLEM (2) Parachute or streamer is melted or scorched by hot ejection gases.

SOLUTION: Be sure you have used sufficient recovery wadding to fill a length of two body diameters.

PROBLEM (3) Nose cone fails to separate from body tube.

SOLUTION: Check fit of nose cone in the body tube; be sure no shroud lines are trapped by nose shoulder. Parts should separate easily, but not be loose. If fit is too tight, sand inside of body tube or nose cone shoulder with fine sandpaper.

PROBLEM (4) Nose cone falls off before ejection.

SOLUTION: Fit is too loose. Wrap masking tape on shoulder of nose cone.

PROBLEM(5) Parachute deploys, but wind carries rocket away.

SOLUTION: In windy conditions replace the parachute with smaller 'chute or streamer. Or, "reef" the 'chute by applying a wrap of tape around the parachute shroud lines, halfway up; this prevents the 'chute from opening fully so the model falls faster. Or, cut a spill hole in the center of the parachute.

PROBLEM (6) Hole or crack in rocket allowing ejection gases to leak through.

SOLUTION: Construction at rear of rocket must be air tight when engine is in place.

PROBLEM (7) Failure to deploy recovery device because body tube is too large for proper pressurization.

SOLUTION: Add a stuffer tube, usually made from BT-20 or BT-50. Center stuffer tube inside rocket with paper rings and glue securely in place. Stuffer tube reduces area to be pressurized.

MULTI-STAGING

1. IGNITION

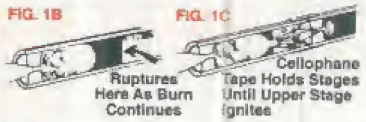
The first stage of a multi-stage rocket is always ignited by standard electrical means. Second stage ignition occurs automatically upon burnout of the first stage. Figure 1A shows that the first stage engine has no delay or ejection charge. This gives instant ignition of the next stage at burnout.

FIG. 1A

In figure 1B the propellant is partially burned, leaving a large combustion chamber. As the propellant continues to burn, the wall of propellant becomes thinner until it cannot withstand the high pressure inside the chamber. At this point the remaining propellant wall ruptures, and the high pressure blows forward toward the nozzle of the next stage, carrying hot gases and small pieces of burning propellant into the nozzle of the second stage engine. This action is illustrated in figure 1C.

FIG. 1B

FIG. 1C



For this system to work, the stages must be held together until the upper stage engine has ignited. When this happens, the stages must then separate in a straight line. This is accomplished by wrapping one layer of cellophane tape around the joint between engines and then recessing this joint 1/2" rearward in the booster body tube, as in figure 2. Recessing the joint forces the stages to separate in a straight line.

FIG. 2

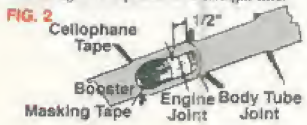
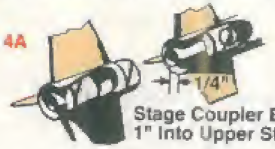


Figure 2 shows the engine installation in a typical two-stage model. Always tape the engines together before inserting them into the rocket. IMPORTANT: Check carefully before and after taping to be sure the engines are in the in proper positions (nozzle of upper stage engine against top end of booster engine). Failure to check carefully can be highly embarrassing as well as damaging to the rocket.

FIG. 3

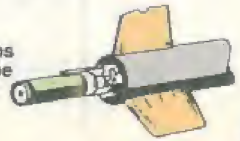
After taping the engines together, wrap masking tape around the upper stage engine at the front and near the rear as in figure 3 to give it a tight fit in the body. Push it into place. Wrap the booster engine and push it into position. Failure to get the upper stage engine in place tightly enough will result in the recovery system malfunctioning; failure to secure the booster stage tightly can result in its dropping off under acceleration.

FIG. 4A



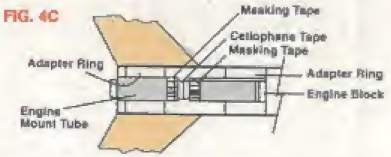
Rockets using large diameter tubes (BT-50 and BT-60) require somewhat different methods, but the same principles of tight coupling and straight line separation must be followed. The recommended coupling method for large diameter tubes is illustrated in figure 4A. The stage coupler is glued to the booster body tube, with the motor adapter for the upper stage engine mount positioned forward to allow the stage coupler to fit into the upper stage, while the motor adapter of the booster engine mount is positioned to the rear.

FIG. 4B



The upper stage engine holder tube projects 1/4" rearward from the end of the upper body tube. The engine is held in place by wrapping a layer of masking tape TIGHTLY around the end of the tube and the end of the engine as in figure 4B. The engine mount in the booster must be built to leave space for this system (see figure 4C). The booster engine is held in place with a wrap of masking tape in the same manner as the upper stage engine.

FIG. 4C



In some multi-stage models the engines cannot be coupled directly together with cellophane tape, such as the case where a D12 is staged to a standard size engine. In this case, use masking tape on the stage couplers as needed to achieve a tight fit between stages, to prevent separation before upper stage ignition.

2. STABILITY

Since two or more engines are mounted near the rear of a multi-stage rocket, it has a tendency to be tail-heavy. To compensate for this, larger fins are often used on the lower stage. Each additional stage requires even greater fin areas. This effect can be minimized if the upper stage is fairly long, increasing the stability of the model.

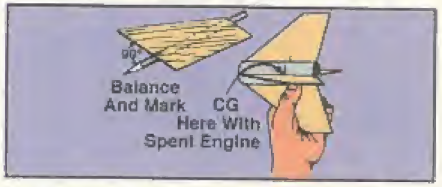
FIG. 5

Fin Area Increased On Each Added Stage

When checking for stability, test first the upper stage alone, then add the next lower stage and test, and so on. In this way you can be sure that the rocket will be stable in each step of its flight, and you can locate any stage which does not have sufficient fin area. Always check for stability with the heaviest engines to be used in place.

3. BOOSTER RECOVERY

Most lower stages are designed to be unstable after separation. The booster should be built so that the center of the area of the fin (its balance point) matches or is up to 1/4" ahead of the booster's balance point with an expended engine casing in place. Thus, boosters will require no parachute or streamer, but will normally tumble, flutter, or glide back to the ground. A booster stage should be painted an especially bright color because it does not have parachute or streamer to aid in spotting it once it is on the ground.



4. TYPES OF ENGINES

Lower and intermediate stages always use engines which have no delay element, and no parachute ejection charge. No delay is used so that the next stage will receive the maximum velocity from its booster. Suitable engines have designations with a "0" delay, such as the B6-0, C6-0, D12-0, and A10-0T.

In the upper stage an engine with a delay and a parachute ejection charge is used. As a general rule the longest possible delay should be used. Engines suitable for upper stage use are those with long delays such as the A8-5, B4-6, C6-7, D12-7, etc.

CLUSTERING

When large models and heavy payloads have to be launched, one engine often cannot supply enough power. A cluster of several engines can be used in this case.

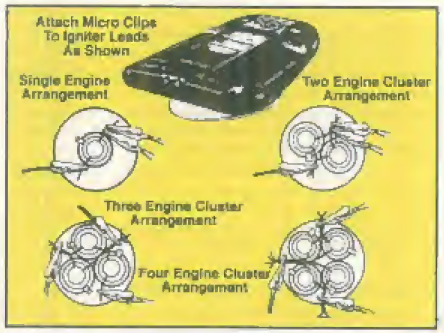
ENGINE ARRANGEMENTS

In designing a clustered model the first rule to remember is that thrust must be balanced around the centerline of the rocket. Figure 1 shows several engine arrangements that satisfy this requirement. All engines should be located close together to keep unbalanced thrust from forcing the model off course.

CLUSTER IGNITION METHODS

Reliable ignition is the most important part of successful clustering. All engines must be ignited simultaneously; this requires a heavy-duty launch controller that can supply high current levels. The Estes Command Control launch controller is designed specifically for cluster ignition. A custom designed controller using a 12 volt car battery for the power supply and a heavy gauge wiring is also suitable.

Carefully install igniters in the cluster engines using igniter plugs in the normal way, making sure the tips of the igniters are touching the propellant and are held firmly in place. Igniters must be connected in parallel—not in series! The easiest way to do this is using "clip whips." Meticulously clean all clips with sandpaper before hooking up the igniters. Every igniter must be connected to one micro-clip from each clip whip. Double-check that one and only one clip from each whip is connected to every engine. At the launcher, check that none of the igniter leads or micro-clips are shorted to each other, to the blast deflector, or to the launch rod. Check one last time that all clips are in place.



GENERAL INFORMATION

Use a heavy-duty launch pad such as the Estes Power Flex launch pad with cluster models. When heavy rockets are being flown, the launch pad should be anchored to the ground with stakes or weights.

The Safety Code requires that you stand at least 30 feet away when igniting an engine or cluster of engines totalling more than 30 Newton-seconds of total impulse.

To legally fly rockets weighing more than one pound or using engines containing more than four ounces of propellant, you may need to notify the Federal Aviation Administration, or obtain an FAA waiver, depending on the type of airspace control over your launch area.

Before installing the engines in your cluster rocket, pack the front of each engine above the ejection end cap with flame-resistant wadding. This eliminates the possibility of one engine's ejection charge igniting the ejection charge of an unignited engine and damaging the rocket. For more complete information on clustering, see Estes Technical Report TR-6.

PAYLOADS

Flying payloads on model rockets is an exciting and challenging activity for both novice and experienced rocket hobbyists. A wide variety of payloads have been flown successfully on model rockets.

Cameras: The Estes Astrocam® camera payload allows even novice rocket flyers to take aerial photos from a rocket. Depending on the engine delay used, the photo can be a vertical shot of the launch area or an oblique view of the nearby landscape. Advanced modelers have adapted and flown auto-sequence 35 mm cameras, movie cameras, and even video cameras on model rockets.

Electronic payloads: These payloads range from simple sonic beacons (such as the Estes Transroc II) that aid in recovering rockets that land in tall grass, all the way to radio transmitters and miniature computers that make temperature or altitude measurements during flight.

Eggs: Launching a raw egg and recovering it unbroken can challenge the payload handling skills of any rocket flyer. The egg must be properly padded to survive the flight; you may want to enclose it in a plastic bag just in case!

Biological payloads: Except for insects, you should NEVER launch a live animal in your rocket. The high launch acceleration or a recovery failure could seriously injure or kill the animal. For a similar challenge, try flying a raw egg.

BOOST-GLIDERS

Boost-gliders are models which fly straight into the air like any other rocket. However, they glide back to earth instead of coming down suspended from a parachute.

There are several types of boost-gliders, including: 1. Rear engine, 2. Front engine, 3. Pop-pod, 4. Variable geometry, and 5. Parasite. Some boost gliders use radio control to allow the modeler to pilot the glider. Although these types appear very different, many of the same principles apply to all.

A boost-glider, as any other rocket, must be stable to fly upward. During glide a model must still be stable, but not by nearly so great a margin. Boost-gliders can accomplish the transition from boost to glide configuration in several ways. Some use a change in balance point, often by ejecting engine pods; others use a shifting of aerodynamic surfaces; still others use combinations of both methods. See TR-4 and TR-7 for further discussion on gliders.

GLIDE TESTING

A boost-glider must be "trimmed" to glide correctly before launching. Some models are trimmed by adjusting the positions of elevons or other aerodynamic control surfaces. Other models are trimmed by adding or removing weight, such as clay, to the nose or tail of the glider.

When trimming a model, give it a straight, smooth, level toss into the wind and note how it glides. If it stalls, add weight to the nose. If it dives, remove weight from the nose. If it turns too much, place a very small weight on the wing tip which is on the outside as it turns.

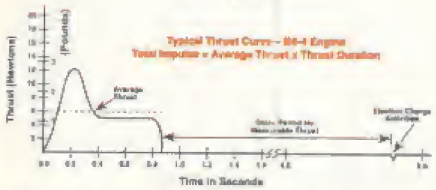
Few models are as spectacular in flight and as enjoyable to watch as a good boost-glider. The modeler looking for a challenge will find that developing improved boost-glide designs is one of the most rewarding areas of research in model rocketry.

MODEL ROCKET ENGINES

Today's rocket flyers can choose from a large variety of engines to power their models, with an engine available for almost every purpose. NOTE: The rocket engine design and performance information given here is for educational purposes only. We believe that knowing how rocket engines work will increase your understanding of science and help you design better rockets for specific purposes. Manufacturing rocket engines is an inherently dangerous activity that should only be attempted by professionals!

OPERATION

The figures below show the internal structure and thrust curve of a typical model rocket engine.



The combustion of the solid propellant produces high temperature, high pressure gases that are ejected through the nozzle. The reaction to forcing the exhaust out the nozzle is a forward thrust (an example of Newton's Third Law of Motion). During the thrust phase the model rocket accelerates upward, gaining velocity and altitude.

After propellant burnout, the delay element is ignited. The delay material is slow-burning; it produces tracking smoke, but negligible thrust. The delay allows the rocket to coast to peak altitude before igniting the ejection charge.

The rapidly-burning ejection charge produces a burst of gas to pressurize the body tube and activate the recovery system of the model.

ENGINE CODES

Model rocket engines are labeled with a three-part classification code ("B6-4", for example) that describes the performance parameters of the engine. You must understand this code in order to choose the proper engine for your model.

The first part of the engine code is a letter designating the motor's TOTAL IMPULSE class (the "B" in B6-4). You can think of total impulse as the total power the engine produces. Technically, total impulse is a measure of the momentum change the engine can impart to the rocket, measured in Newton-seconds. In practical terms, an engine with greater total impulse can lift a rocket higher and faster, and can lift heavier rockets, than an engine with lower total impulse. The table below gives the total impulse ranges and typical rocket performance for each class.

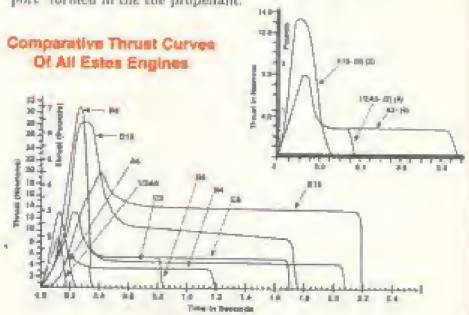
TYPE CODE	TOTAL IMPULSE Newton Sec	ALTITUDE RANGE OF TYPICAL MODELS meters	APPROX. ALTITUDE OF 80 gram RTF ROCKET meters
1/4 A	0 - 0.625	10 to 75	3 (not rec.)
1/2 A	0.626 - 1.25	20 to 120	30
A	1.26 - 2.50	40 to 250	60
B	2.51 - 5.00	80 to 400	110
C	5.01 - 10.00	80 to 900	250
D	10.01 - 20.00	400 to 750	440
E	20.01 - 40.00	120 to 900	760
F	40.01 - 80.00	160 to 1500	N.A.

The second part of the engine code (the "6" in B6-4) gives the AVERAGE THRUST of the engine, measured in Newtons. The Newton is a measure of force; 1 pound equals 4.45 Newtons. The greater the thrust of an engine, the harder it pushes on the rocket and the faster the rocket will accelerate. The B8 and B4 are both B engines (so they have the same total impulse) but the greater thrust of the B8 will cause a rocket to leap into the air much faster.

The third part of the engine code follows the dash (the "4" in B6-4); this number is the TIME DELAY, in seconds, between burnout of the propellant and activation of the ejection charge. This delay allows the rocket to coast to peak altitude before deployment of the recovery system. The proper choice of delay time depends on how long it takes a rocket to reach peak altitude with a particular engine. Engines with codes ending in "-0" are booster engines; they do not contain delay and ejection charges. There is also a special type of "plugged" engine with codes ending in "-P"; these are useful in radio-control gliders where no ejection or booster blow-through is desired.

THRUST CURVES

Estes engines come in different types including end-burning and semi-core-burning. The different thrust curve shapes of these two types are primarily the result of the depth of the "port" formed in the the propellant.



The most common model rocket engine is the end-burner, which has a shallow port. This design is used in many Estes engines and is especially effective with lightweight high performance rockets. The high initial thrust boosts the rocket to a suitable flying speed almost immediately; thrust then drops to a lower sustaining level to maintain speed and gain the most distance with the least fuel consumption.

For heavy rockets, especially those carrying large payloads, semi-core-burning Estes engines are available. These engines have deeper ports, producing a very high initial thrust peak due to a larger surface area for propellant burning. The B8 and C5 engines are semi-core-burners.

SELECTING THE CORRECT ENGINE

Always use an appropriate engine to fly your rocket. Just because an engine fits in the model does not mean it is a suitable engine! When flying an Estes rocket, consult the Estes catalog or the kit instructions for a list of engines recommended for that model.

If the launch field is small, or if the weather conditions are windy, use a lower total impulse engine to increase your chances of recovering the rocket. If you are launching a heavy payload in a model, it may be necessary to use an engine with a shorter time delay than is recommended for the rocket without a payload.

Computer software, such as the Estes ASTROCAD program, is helpful in selecting the proper engine size and delay time to use in a rocket.

ENGINEERING AND QUALITY CONTROL

Today the Estes engine represents the result of over 35 years' effort in engineering, craftsmanship and quality control. The total impulse of Estes engines is closely controlled, which allows us to make our engines very near the maximum permissible size in a given class.

Three out of every hundred engines made by Estes Industries are static tested on a recording type of test stand which graphically records the maximum thrust, thrust variations, minimum thrust, overall thrust duration, length of time delay, and the strength of the ejection charge. Any batch of engines which does not meet rigid standards is discarded. All tolerances are kept as small as possible so that these engines make excellent propulsion units for contests, exhibitions and science studies.

SAFETY

Rocket engines are not toys, but scientific devices. With common sense and close adherence to safety rules, model rocketry is as safe as any other sport, hobby, or scientific study. Carelessness can make it dangerous, as with model airplanes, baseball or swimming. If you are hit by a model rocket traveling 300 or more miles per hour, you will be hurt. Use common sense and follow the safety code. Don't spoil model rocketry's excellent record of safety.

MODEL ROCKET PERFORMANCE

Several factors affect the altitude performance of model rockets.

ENGINE SIZE

The greater the total impulse of an engine, the higher it will boost a model. The approximate altitudes achieved by typical single stage rockets are listed in the table on page 12; high performance models can exceed these values. The kits, components, and engines produced by Estes Industries have been designed to cover the entire performance range from low altitude sport and demonstration models to high altitude, high performance payload and competition rockets.

WEIGHT

In most cases, the heavier a rocket, the lower the altitude it will reach. A baseball can be tossed higher than an 8 pound bowling ball; the same holds true for model rockets. In addition heavier rockets are more apt to tilt at an angle as they leave the launcher, reducing altitude even more.

Weights listed for rocket kits in the catalog do not include engines. To determine the lift-off weight of a model, add the engine weight, shown in the engine selection chart, to the kit weight. Remember to also add the weight of any payload carried in the rocket.

Use high-thrust engines with heavy rockets to insure adequate lift-off speed. The lift-off weight of the rocket must not exceed the Maximum Liftoff Weight for the engine being used (see the engine tables in your Estes catalog).

DRAG

Drag, or wind resistance, is the third item which affects performance. The more drag on a rocket, the lower the altitude it will reach. A number of factors determine the amount of drag on a rocket. The more frontal area the rocket has, the greater its drag will be. As a result, large diameter model rockets will generally not reach as great an altitude as smaller diameter rockets with the same engine power. Rough surfaces create turbulence in the air as it flows past the rocket, increasing drag. Smooth finishes will increase the capability of the model. The stability of the rocket also affects drag – if it wobbles in flight, it will have greater drag. Careful attention to reducing drag can sometimes double a rocket's altitude performance.

NAR SAFETY CODE

1. Materials–My model rocket will be made of lightweight materials such as paper, wood, rubber, and plastic suitable for the power used and the performance of my model rocket. I will not use any metal for the nose cone, body, or fins of a model rocket.

2. Engines–I will use only commercially-made NAR certified model rocket engines in the manner recommended by the manufacturer. I will not alter the model rocket engine, its parts, or its ingredients in any way.

3. Recovery–I will always use a recovery system in my rocket that will return it safely to the ground so it may be flown again. I will use only flame-resistant recovery wadding if required.

4. Weight Limits–My model rocket will weigh no more than 1500 grams (53 oz.) at lift-off, and its rocket engines will produce no more than 320 Newton-seconds (4.45 Newtons equal 1.0 pound) of total impulse. My model rocket will weigh no more than the engine manufacturer's recommended maximum lift-off weight for the engines used, or I will use engines recommended by the manufacturer for my model rocket.

5. Stability–I will check the stability of my model rocket before its first flight, except when launching a model rocket of already proven stability.

6. Payloads–Except for insects, my model rocket will never carry live animals or a payload that is intended to be flammable, explosive, or harmful.

7. Launch Site–I will launch my model rockets outdoors in a cleared area, free of tall trees, power lines, buildings, and dry brush and grass. My launch site will be at least as large as that recommended in the following table.

LAUNCH SITE DIMENSIONS

Installed Total Impulse (Newton-Seconds)	Equivalent Engine Type	Minimum Site Dimension (feet)	(meters)
0.00 – 1.25	1/4A & 1/2A	50	15
1.26 – 2.50	A	100	30
2.51 – 5.00	B	200	60
5.01 – 10.00	C	400	120
10.01 – 20.00	D	500	150
20.01 – 40.00	E	1000	300
40.01 – 80.00	F	1000	300
80.01 – 160.00	G	1000	300
160.01 – 320.00	2Cs	1500	450

8. Launcher–I will launch my model rocket from a stable launching device that provides rigid guidance until the model rocket has reached a speed adequate to ensure a safe flight path. To prevent accidental eye injury, I will always place the launcher so that the end of the rod is above eye level or I will cap the end of the launch rod when approaching it. I will cap or disassemble my launch rod when not in use and I will never store it in an upright position. My launcher will have a jet deflector device to prevent the engine exhaust from hitting the ground directly. I will always clear the area around my launch device of brown grass, dry weeds, and other easy-to-burn materials.

9. Ignition System–The system I use to launch my model rocket will be remotely controlled and electrically operated. It will contain a launching switch that will return to "off" when released. The system will contain a removable safety interlock in series with the launch switch. All persons will remain at least 15 feet (5 meters) from the model rocket when I am igniting model rocket engines totalling 30 Newton-seconds or less of total impulse or less and at least 30 feet (9 meters) from the model rocket when I am igniting model rocket engines totalling more than 30 Newton-seconds of total impulse. I will use only electrical igniters recommended by the engine manufacturer that will ignite model rocket engine(s) within one second of actuation of the launching switch.

10. Launch Safety–I will ensure that people in the launch area are aware of the pending model rocket launch and can see the model rocket's liftoff before I begin my audible five-second countdown. I will not launch a model rocket using it as a weapon. If my model rocket suffers a misfire, I will not allow anyone to approach it or the launcher until I have made certain that the safety interlock has been removed or that the battery has been disconnected from the ignition system. I will wait one minute after a misfire before allowing anyone to approach the launcher.

11. Flying Conditions–I will launch my model rocket only when the wind is less than 20 miles (30 kilometers) an hour. I will not launch my model rocket so it flies into clouds, near aircraft in flight, or in a manner that is hazardous to people or property.

12. Pre-Launch Test-When conducting research activities with unproven model rocket designs or methods I will, when possible, determine the reliability of my model rocket by pre-launch tests. I will conduct the launching of an unproven design in complete isolation from persons not participating in the actual launching.

13. Launch Angle-My launch device will be pointed within 30 degrees of vertical. I will never use model rocket engines to propel any device horizontally.

14. Recovery Hazards-If a model rocket becomes entangled in a power line or other dangerous place, I will not attempt to retrieve it.

As a member of the Estes Model Rocketry Program, I promise to faithfully follow all rules of safe conduct as established in the above code.

Signature _____

*This is the official Model Rocketry Safety Code of the National Association of Rocketry and the Model Rocket Manufacturers Association.

Estes Note: The largest "model" rocket engine as defined by CPSC is an "F" (80 NS). To launch rockets weighing over one pound including propellant or rockets containing more than 4 oz. of propellant (net weight), you must obtain a waiver from the FAA. Check your telephone directory for the FAA office nearest you.

PUBLICATIONS AVAILABLE FROM ESTES

Model Rocket News Magazine

Provides articles of interest, technical tips, information about new products, special offers, and much more. Available to ESP members and through local retailers.

Alpha Book of Model Rocketry

An informative book for beginners in model rocketry. 32 pages.

EST 2820

The Laws of Motion and Model Rocketry

The three laws of motion are explained in easily understood terms. Simple examples and experiments are included. 12 pages.

EST 2821

Estes Guide for Aerospace Clubs

The perfect source book for organizing and operating a successful model rocket club or ESP chapter. 34 pages.

EST 2817

Model Rocket Contest Guide

Use to plan model rocket contests for clubs or schools. Details on competitive events and suggestions on all facets of contest organization. 18 pages.

EST 2815

Projects in Model Rocketry

Suggestions on how to plan, prepare, and present research projects, ideas for about one hundred projects.

EST 2831

Model Rocket Launch Systems

Contains a wealth of information. Photographs and clearly-drawn schematics make it easily understood. 20 pages.

EST 2811

The Classic Collection

A comprehensive collection of technical reports and notes that make a valuable reference tool. Includes TR-1 through TR-7 and TN-1, TN-3, TN-4, and TN-6.

EST 2845

Model Rocketry Study Guide

A logical program for anyone who wants the most from model rocketry. Guides a beginner on the path to becoming an expert rocketeer.

EST 2841

Altitude Prediction Charts

A simple system by which aerodynamic drag and other effects can be taken into account in predicting rocket peak altitudes. Technical Report TR-10.

EST 2842

Aerodynamic Drag of Model Rockets

Gives practical examples of ways to minimize aerodynamic drag and improve performance. Technical Report TR-11.

EST 2843

Elementary Mathematics of Model Rocket Flight

Information on how to make your own altitude tracker and calculate speeds and accelerations. Technical Note TN-5.

EST 2844

Model Rocketry Technical Manual

Handy guide for construction and flight of model rockets. Tips on "scratch building", launch systems, tracking, staging, boost-gliders, and more.

EST 2819

Estes Educator News

Interesting technical articles, new product information, plus activities and resources on space and model rocketry subjects suitable for classroom use. Available through many local retailers.

Guide for Teachers and Youth Group Leaders

Introduces you to Estes' model rocket technology and the complete services offered in our educational program.

EST 2814

Industrial Arts Teachers Manual for Model Rocketry

Very practical 52 page guide on model rocketry and its applications in the study of manufacturing, transportation, R&D, communications, and construction.

EST 2810

Camp Leader's Model Rocketry Manual

Proven guide for introducing model rocketry successfully into camp programs. 10 pages.

EST 2822

Video - Model Rocketry - The Last Frontier*

Capture the excitement of model rocketry in this full color VHS video presentation, narrated by and featuring William Shatner of Star Trek** fame! An excellent primer to model rocketry with dramatic launch footage and graphic, easy-to-understand illustration. 15 minutes.

EST 2792

EST 2819

Estes Industries
1295 H Street
Penrose, CO 81240

MANIAC™
EST 2091
$9.99*

SHADOW™
EST 2094
$26.99

PHOENIX™
EST 1380
$21.49

MANIAC™

You have to be crazy not to like this low-cost performer. Quick building, no painting, heavy-duty construction, and it flies on "E" engines to over 2000 feet! The Maniac™ also uses "D" engines, and with the optional quick-change engine mount (EST 3154) even flies on "C"s. Requires a 5 mm (3/16") Maxi™ Rod (EST 2244) or a 6 mm (1/4") launch rod to launch.

Specifications:
Length: 78.3 cm (30.8"); Dia.: 340.04 mm (1.34"); Wt.: 130 g (4.6 oz.); Engines: D12-5 (First Flight), D12-7, E15-6, E15-8; With optional EM-2050 (EST 3154) - C5-3, C6-3
*Special Introductory Price

SHADOW™

No hiding this rocket – it's nearly four feet tall and 2.6 inches in diameter. The Shadow™ flies majestically to over 550 feet on "E"s and can be powered by "D" engines too! Kit includes a massive self-adhesive decal. Requires a 5 mm (3/16") Maxi™ Rod (EST 2244) or 6 mm (1/4") rod to launch. **Specifications:**
Length: 120.7 cm (47.5"); Dia.: 66 mm (2.6"); Wt.: 239 g (8.5 oz.); Engines: D12-3 (First Flight), E15-4, E15-6

PHOENIX™

Huge, gorgeous 1/9 semi-scale model of the famous Phoenix™ air-to-air supersonic missile. This long-time Estes favorite has been upgraded to take "E" engines – it now flies to 900 feet! Magnificent for display or flight! Requires a 5 mm (3/16") Maxi™ Rod to launch.
Specifications:
Length: 76.2 cm (30"); Dia.: 66 mm (2.6"); Wt.: 186.8 g (6.6 oz.); Engines: D12-3 (First Flight), E15-4, E15-6

Estes Challenge series

Engines, launch system, glue, and finishing supplies not included.
Avg. Ship Wt. 453 g (16 oz.)

COMANCHE-3™
EST 1382
$12.79


SR-71 BLACKBIRD™
EST 1942
$15.99

COMANCHE-3™
If two stages are not enough, here's three. And to really get this show moving fast, there is a "D" engine in the first stage. This rocket can fly over 1/2 mile in altitude and is recovered with a streamer. Can also be flown in a single or two stage configuration. A 5 mm (3/16") Maxi-Rod™ (EST 2244) is required for launch.

Specifications:
Length: 104.1 cm (41.0"); Dia.: 24.8 mm (0.976"); Wt.: 58.9 g (2.08 oz.); Engines: single stage configuration: A8-3 (First Flight), B4-4, B6-4, B8-5, C6-5; multi stage configuration: upper (top) stage - A8-5 (First Flight), B4-6, B6-6, C6-7, second stage - B6-0 (First Flight), C6-0, first stage - D12-0

SR-71 BLACKBIRD™
Jet black, lean and mean, the SR-71 smashed numerous speed and altitude records as far back as 1965. Some still stand after more than 25 years! After three decades of service, the SR-71 is now used by NASA for testing propulsion systems and materials for use in the X-30 program.

Specifications:
Length: 48.3 cm (19"); Dia.: 24.8 mm (0.976"); Wt.: 90.6 g (3.2 oz.); Engines: B4-2 (First Flight), B6-2, B6-4, B8-5, C6-5

• *Amazing Swing-Wing Action!*

New!

TOMCAT™ Swing-Wing Rocket Glider
EST 2086
$15.99

BROADSWORD™
EST 2093
$19.99

TOMCAT™ Swing-Wing Rocket Glider
Out of the Estes skunk works, the Tomcat™ is ready for action! Climbs vertically with the wings swept back, then the engine's ejection charge activates the release mechanism, and the wings sweep forward into glide mode. The Tomcat™ soars down into a graceful circling glide path. Replace the engine, sweep the wings back, reset the release mechanism, and you're ready to go ballistic!

Specifications:
Length: 53.7 cm (21.12"); Wingspan: Swept - 26.0 cm (10.25"), Extended - 47.3 cm (18.63"); Wt.: 115 g (4.1 oz.); Engines: C6-3 (First Flight), C6-3

BROADSWORD™
Powered by "E" engines (but can fly on "D"s too!), this rocket boasts altitudes of almost 1,000 feet! The Broadsword is three feet tall, 2.6 inches in diameter, decked by a huge self-adhesive decal and features slow, realistic lift-offs. The Broadsword makes a bold statement! Requires a 5 mm (3/16") Maxi™ Rod (EST 2244) or 6 mm (1/4") rod to launch.

Specifications:
Length: 92.7 cm (36.5"); Dia.: 65 mm (2.56"); Wt.: 171 g (6 oz.); Engines: D12-3 (First Flight), D12-5, E15-4, E15-6

ESTES Masters™ SERIES

This is the goal of every rocket builder. These are flying rockets that are aimed at the serious rocket modeler - the modeler who likes the emphasis to be on construction. The Saturn V™ is the flagship of this series, an impressive model whether on the pad or on display. The accurately-detailed, fully-stacked Space Shuttle™ features an actual gliding shuttle. Highly detailed models from the Star Trek® world also grace this level - the USS Enterprise™ and the infamous Klingon™ Battle Cruiser.

Master™ Series instills patience, quality, and skill along with construction satisfaction and flying fun.

Engines, launch system, glue, and finishing supplies not included.
Avg. Ship Wt. 504 g (18 oz.)

NOW POWERED BY "D" OR "E" ENGINES

SATURN V™
EST 2001
$52.99

SATURN V™

On July 20th, 1969, humankind's greatest adventure had reached its climax. The world held its collective breath as Neil Armstrong gently placed a footprint on the moon. The first man on an alien world...it was a giant leap. Estes celebrates that historic moment with the 25th anniversary commemorative Saturn V™ - the vehicle that took the Eagle lunar lander to the moon. This special edition contains a special 25th anniversary poster, sticker and a coupon for a factory rebate. The kit itself is a magnificently detailed 1/100 scale model - from the plastic molded escape tower and Apollo capsule, to the highly accurate decals, down to the detailed plastic F-1 engines. At 1/100th scale, this model stands an impressive three and one half feet tall and is over four inches in diameter. Extensive detailing includes the corrugations on the fuel tanks (special embossed body wrappers) and external details such as the vents, separation motors, system tunnels, etc. (molded plastic). The Estes Saturn V™ has now been modified to accept E15 engines. This model will draw nods of appreciation from master modelers and envy from the novices. The Estes Saturn V™ requires a 5 mm (3/16") Maxi™ rod or a 6 mm (1/4") rod to launch - not included

Specifications:
Length: 109.9 cm (43.25"); Dia.: 100 mm (3.94"); Wt.: 288.7 g (10.12 oz.); Engines: E15-4 (First Flight), D12-3

ESTES Masters™ SERIES

STARSHIP ENTERPRISE®
EST 1275

KLINGON™ BATTLE CRUISER
EST 1274
$25.99

CHALLENGE™ SERIES

These two commemorative kits were re-released in 1992 to celebrate the 25th anniversary of Star Trek®. These flying model kits originally appeared in 1975.

STARSHIP ENTERPRISE® $25.99

This "Constellation"-class starship was the flagship of the Federation. Its mission encompassed galactic security and exploration. Our version requires special modification (with the addition of a recovery probe) to fly in our atmosphere. The recovery probe can easily be disengaged. Other features include vacuum-formed plastic parts and highly accurate decals.

Specifications:
Length: 42.6 cm (16.8"); Recovery Probe Length: 77.2 cm (30.4"); Primary Hull Dia.: 19 cm (7.5"); Wt.: 110 g (3.8 oz.); Engines: B6-2 (First Flight), C6-3

KLINGON™ BATTLE CRUISER

In the 23rd century, the Klingon® Empire was the primary enemy of the Federation. The Battle Cruiser, with its fierce warriors and powerful weaponry, was the mainstay weapon platform of the Klingons. Our Klingon® replica features vacuum-formed plastic parts, water transferable and special chrome-colored self-adhesive decals.

Specifications:
Length: 39.4cm (15.5"); Wingspan: 24.9 cm (9.8"); Wt.: 70. g (2.5 oz.); Engines: B4-2 (First Flight), B6-4, C6-5

SPACE SHUTTLE™
EST 1284
$24.99

EXPLORER AQUARIUS™
EST 2016
$19.99

SPACE SHUTTLE™

Accurately detailed 1/162 scale model of America's most famous space vehicle. Like the real one, the orbiter glides back to Earth, while the external tank and boosters return under a 46 cm (18") parachute. Removable stabilizer fins plug in for flight. A great display and demonstration model.

Specifications:
Total Length: 34.5 cm (13.6"); Orbiter Length: 22.9 cm (9"); Orbiter Wingspan: 18 cm (7.1"); Weight: 124 g (4.37 oz.); Engines: C5-3 (First Flight), C6-3

EXPLORER AQUARIUS™

Excerpted from Mary's Compendium On Interstellar Craft, disk 2, ed. 123, published in 2286: Early 22nd century (completed in 2111, launched in 2114)...manned star probe...utilized first suspended animation system...lost contact in 2197. Our beautiful model features "D" power, a unique plastic nose cone and two huge decal sheets. Requires a 5 mm (3/16") Maxi-Rod™ (EST 2244).

Specifications:
Length: 55.2 cm (21.75"); Dia.: 69.9 mm (2.75"); Wt.: 118.9 g (4.2 oz.); Engines: D12-3 (First Flight), D12-5

PRO™ SERIES
SKILL LEVEL 4

Estes high-powered product line can be found in the Pro™ Series. These are large models using, at the very least, single or clustered-"D" engines. All models also use the more powerful "E" engine. Engineered for performance and safety, we only recommend these rockets for modelers 16 years of age or older.

Rockets in this line feature rugged, yet simple construction designed to withstand the stresses of higher-powered flight. What do you get when you combine heavy-duty body tubes, through-the-wall fin mounting, plywood centering rings and rip-stop nylon parachutes? Models that are tough, but surprisingly lightweight.

Plus, we have the right accessories to go with these impressive models - The Command Control™ launch controller and the Power Plex™ launch pad. These are the ultimate in ruggedness, versatility and safety.

Engines, launch system, glue, and finishing supplies not included.
Avg. Ship Wt. 1 Kg (2.2 lbs.)

These models require a 6 mm (1/4") launch rod and a heavy duty launch system such as the Power Plex™ and the Command Control™.

TERRIER/SANDHAWK™
EST 2083
$30.99

JAYHAWK™
EST 2085
$35.99

TERRIER/SANDHAWK™

Nearly four feet tall, this lightweight, but strongly-built 1:9.8 scale model is an excellent performer. Flies single stage in two configurations: as is or detach the Sandhawk™ and fly it alone! Scale data and documentation included.

Specifications:
Length: 116.8 cm (46.0"); Dia.: 46.6 mm (1.835"); Wt.: 244 g (8.6 oz.); Engines: Terrier/Sandhawk™ - D12-3, E15-4; Sandhawk™ - D12-5 (First Flight), E15-6; With EM-2050 Adapter - B4-2, B6-2, C6-3

JAYHAWK™

A magnificent, highly-detailed 1/5th scale model of the U.S. Navy's supersonic AQM-37A Missile Target drone. This unique-looking rocket will become your favorite, whether on display or in the air. The Jayhawk™ kit features giant, colorful, scale, water-transferable decals; a nylon parachute; slotted heavy-duty body tube, and plastic-molded nose cone and conduit.

Specifications:
Length: 76.2 cm (30"); Dia.: 63.5 mm (2.5"); Wt.: 245 g (8.6 oz.); Engines: D12-3 (First Flight), E15-4

ESTES PRO SERIES™ MODEL ROCKETS

These models require a 6 mm (1/4") launch rod and a heavy duty launch system such as the Power Plex™ and the Command Control™.

Now can be powered by "E"s

IMPULSE™
EST 2064
$44.99

PATRIOT™
EST 2066
$59.99

MAXI-FORCE™
EST 2065
$54.99

IMPULSE™

The power of two "D" engines, ignited simultaneously, whip this rocket into the air. The racy Impulse™ makes the introduction to clustering simple. This rocket is easy to build for the experienced rocket modeler. The Impulse™ features the standard heavy-duty Pro™ Series construction.

Specifications:
Length: 94 cm (37"); Dia.: 63.5 mm (2.5"); Wt.: 235 g (8.3 oz.); Engines: (two required) D12-5 (First Flight), D12-7, E15-6, E15-8

PATRIOT™

This is one HUGE 1/5 scale model of the Desert Storm veteran. The thunder and smoke of four "E"s, clustered together, hurl this model missile to over 1500 feet. This rocket is a rewarding build for the experienced modeler. Scale-contoured fins and conduits along with a highly-detailed decal sheet enhance this kit.

Specifications:
Length: 99 cm (39"); Dia.: 76.2 mm (3"); Wt.: 348 g (12.3 oz.); Engines: (four required) D12-5, D12-7, E15-6, E15-8
*FAA notification or waiver may be required to fly this rocket.

MAXI-FORCE™

With the combined force of three "E" engines, this huge bird roars to over 1600 feet altitude on a column of smoke. Definitely an attention-getter! Rugged construction and a tough rip-stop nylon parachute assure reliable, high-powered flights.

Specifications:
Length: 127cm (50"); Dia.: 63.5 mm (2.5"); Wt.: 348 g (12.3 oz.); Engines: (three required) D12-7, E15-6, E15-8
*FAA notification or waiver may be required to fly this rocket.

STAR WARS®

Now you can own these artifacts from a long time ago in a galaxy far, far away! Estes is pleased to reintroduce these Commemorative Series models from the exciting **Star Wars** saga.

X-wing Fighter™
EST 2103
$16.99

R2-D2™
EST 2104
$24.99

TIE Fighter™
EST 2102
$21.99

X-wing Fighter™

A scale reproduction of the X-wing fighter piloted by Luke Skywalker. The Estes X-wing features a blow-molded, plastic fuselage, detailed plastic parts, die-cut balsa wings and authentic decals. Not only is the X-wing great for display, but it flies to over 300 feet!

Specifications:
Length: 27.6 cm (10.9"); Wing Span: 22.5 cm (8.9"); Dia.: 33.6 mm (1.4"); Wt.:99.2 g (3.5 oz.); Engines: C6-3

R2-D2™

Estes is pleased to give you the flying version of the famous R2-D2 droid. Our R2-D2 is a 1/5 scale model standing nine inches tall. Kit includes a molded plastic body dome and tail cone, molded plastic legs and a detailed, self-adhesive body wrapper.

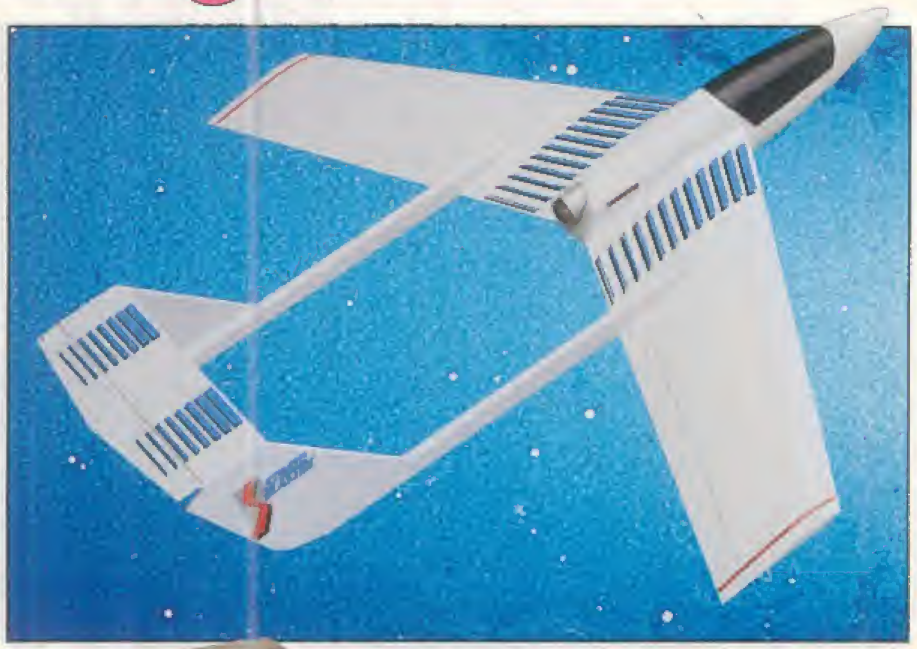
Specifications:
Length:22.8 cm (9"); Dia.: 95.1 mm (3.74"); Wt.: 146 g (5.1 oz.); Engines: B6-2 (First Flight), C6-3

TIE Fighter™

For every good guy there's a bad guy. Estes presents the Imperial Forces TIE fighter. Kit features include a highly-detailed plastic cockpit and fuselage and vacuum-formed plastic energy panels. The Estes version requires a special stabilizing recovery probe for flight, which easily removes for display.

Specifications:
Length: 13.7 cm (5.4"); Wing Span: 12.7 mm (5"); Flying Length w/Probe: 53.2 cm (21"); Wt.: 107.4 g (3.8 oz.); Engines: C6-3

r/c gliders



These radio-controlled aircrafts are for the model aviation enthusiast who is looking for something unique. Rocket-powered model aircraft require R/C experience and R/C gear (servos, receivers, transmitters,etc.)

STRATO BLASTER™
EST 2090
$69.99

STRATO BLASTER™
Go ballistic with our next generation of rocket-powered R/C gliders! The Strato Blaster™ features a blow-molded fuselage, covered foam wings and die-cut balsa parts. The Strato Blaster™ flies on E15-Ps (about 600 feet) or D11-Ps, can be converted to fly R/C with an .049 glow engine, and is an excellent slope glider! The Strato Blaster™ requires R/C experience to fly, two-channel (minimum) mini or micro gear (R/C gear not included) and a 5 mm (3/16") Maxi™ Rod (EST 2244) or a 6 mm (1/4") launch rod to launch. (The Estes Power Plex™ Launch Pad (EST 2235) is recommended.)
Specifications:
Wingspan: 87.6 cm (34.5"); Length: 81.3 cm (32"); Wing Area: 14.1 sq. dm. (219 sq. in.); Wt. (typical): 369-454 g (13-16 oz.); Wing Loading (typical): 28.1 g/sq.. dm. (9.2 oz./sq. ft.); Power: D11-P, E15-P, .049 glow engine

Engines, launch system, glue, and finishing supplies not included
Avg. Ship Wt. 580 g (20 oz.)

- ***Converts to .049 Glow Power in Seconds!***

ASTRO-BLASTER™
EST 2073
$79.99

- ***"E" Engines***

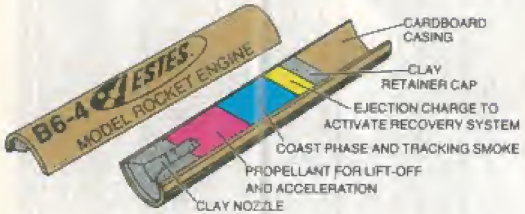
ASTRO-BLASTER™
A new dimension in excitement for rocket enthusiasts and R/C modelers alike. Combining rocket boost glider technology with R/C aerobatic capability gives a model that delivers maximum flying fun! Includes a quick-change adapter for .049 glow engine power. In seconds, the Astro-Blaster™ transforms into an aerobatic power ship, R/C rocket glider, slope soarer, .049-powered sport flier: 3-in-1 versatility! Features conventional quality model aircraft construction and requires two channel radio equipment with mini or micro flight pack (not included). Requires 5 mm (3/16") Maxi™ rod (EST 2244) or a 6 mm (1/4") launch rod to launch.
Specifications:
Wingspan: 91.4 cm (36"), Wt. (typical): 397 g (14 oz.); Wing Loading (typical): .026 g/sq. cm (8.6oz./sq. ft.); Power: D11-P, E15-P, .049 glow engine

ENGINES OVER 35 SAFE YEARS

Safe, intelligent design, precise manufacture and strict engineering tolerances have made Estes model rocket engines the standard in the industry. They have been proven consistent and reliable in more than 300,000,00 launches.

Some important features are:

- Lightweight non-metallic casings made from specially formulated paper with clay nozzles
- Pre-loaded with propellant - the modeler does not handle any hazardous materials
- Estes engines comply with the codes of the National Fire Protection Association and are certified by the National Association of Rocketry.
- 3% of all Estes engines made are static-tested at the factory for reliability and adherence to performance specifications. If our standards aren't met, the engines are rejected and don't make it to market.
- The concept of the pre-assembled model rocket engine is the foundation of this safe, scientific and educational activity.



B **6** **4**

TOTAL IMPULSE

Unit = Newton-seconds

This letter indicates the **total impulse range** of the engine. **Total impulse** is the total power the engine produces, which basically indicates how much propellant it contains. Total impulse is measured in Newton-seconds. One Newton-second is the amount of total impulse produced by one Newton of thrust for a duration of one second. A five Newton-second engine ("B" type) could produce five Newtons of thrust for one second, ten Newtons for 1/2 second, or any combination that equals five Newton-seconds when multiplied. The chart below shows the possible values for each engine type.

AVERAGE THRUST

Unit = Newton

This number tells you the **average thrust** the motor delivers during the thrust phase. The **actual thrust** varies, and is shown on the time-thrust curve (see example below). For a particular engine size, let's say a "B", the propellant may be burned quickly, giving high thrust for a short time, or slowly, giving lower thrust for a longer time. A higher average thrust engine (B8) is best for heavier models, while a lower average thrust, longer burn engine (B4) is more efficient in smaller, lighter models.

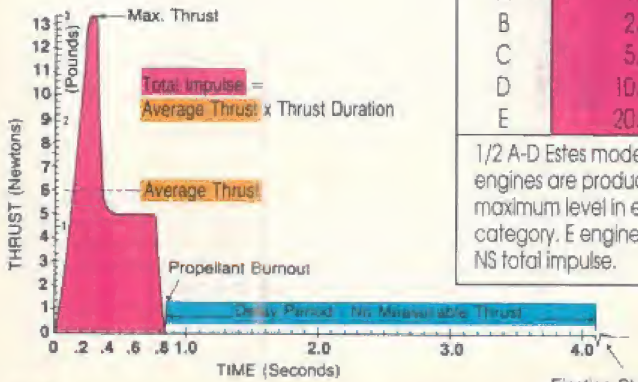
TIME DELAY

Unit = seconds

The **time delay** is the number of seconds between the end of the thrust phase (propellant burned) and activation of the ejection charge. The time delay allows the model to coast to its peak altitude before the recovery system is deployed. The kit instructions and this catalog list the current engine choices for your model.

TYPE	TOTAL IMPULSE
1/2A	0.626- 1.25
A	1.26- 2.50
B	2.51- 5.00
C	5.01-10.00
D	10.01-20.00
E	20.01-40.00

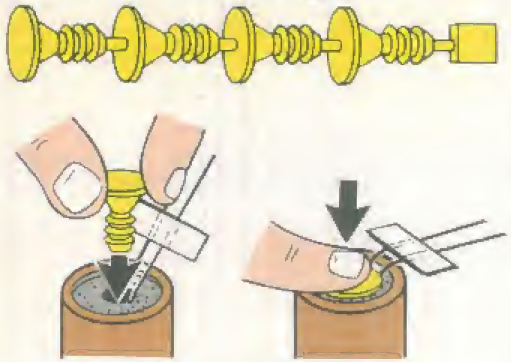
1/2 A-D Estes model rocket engines are produced at the maximum level in each category. E engines provide 32 NS total impulse.



B6-4 Time Thrust Profile

IGNITER PLUGS - *Use Only with Estes Engines*

Smart technology! Estes igniter plugs securely lock the igniter in place for dependable, safe ignition. Makes misfires due to incorrect igniter installation a thing of the past. Plus, they're reusable! Color-coded and tagged for easy identification. Igniter plugs are now included with all Estes engines.



Engine Type		Plug Color
MINI	1/2A3, A3	Orange
	A10	Green
REGULAR	A8, B4	Yellow
	B6, C6	Magenta
	B8, C5	Blue
D	D11, D12	White
E	E15	Red-Orange

COLOR CODING:

Estes model rocket engines have color-coded labels that indicate their applications.

Green Label - Single stage models

Purple Label - Upper stage or single stage, if used in very light models

Red Label - "0" delay engines, for use in booster stage and special projects **only**. Contain no delay or ejection charge.

Black Label - Special plugged engines are for R/C gliders. They contain no delay or ejection charge.

REGULAR ENGINES

SINGLE STAGE ENGINES (GREEN LABEL)

Prod. No.	Engine Type	Prices 3 for	Total Impulse lb.-sec.[1]	Total Impulse N-sec.[2]	Time Delay (±15%)	Max. Lift Wt. oz./g	Max. Thrust lb./N	Thrust Duration	Initial Weight oz.	Initial Weight g	Propellant Weight oz.	Propellant Weight g
1593	1/2A6-2*	$4.19	0.28	1.25	2 sec.	2.5/ 70.8	2.88/12.8	0.20 sec.	0.53	15.0	0.055	1.56
1598	A8-3	4.29	0.56	2.50	3 sec.	4.0/113.2	3.00/13.3	0.32 sec.	0.57	16.2	0.110	3.12
1601	B4-2	4.49	1.12	5.00	2 sec.	4.0/113.2	3.00/13.3	1.20 sec.	0.70	19.8	0.294	8.33
1602	B4-4	4.49	1.12	5.00	4 sec.	3.5/ 99.1	3.00/13.3	1.20 sec.	0.74	21.0	0.294	8.33
1605	B6-2	4.49	1.12	5.00	2 sec.	4.5/127.4	3.00/13.3	0.83 sec.	0.68	19.3	0.220	6.24
1606	B6-4	4.49	1.12	5.00	4 sec.	4.0/113.2	3.00/13.3	0.83 sec.	0.71	20.1	0.220	6.24
1620	B8-5*	4.49	1.12	5.00	5 sec.	5.0/141.5	5.00/22.2	0.60 sec.	0.68	19.3	0.220	6.24
1617	C5-3*	5.09	2.25	10.00	3 sec.	8.0/226.4	5.00/22.2	2.10 sec.	0.90	25.5	0.450	12.70
1613	C6-3	5.09	2.25	10.00	3 sec.	4.0/113.2	3.00/13.3	1.70 sec.	0.88	24.9	0.440	12.48
1614	C6-5	5.09	2.25	10.00	5 sec.	4.0/113.2	3.00/13.3	1.70 sec.	0.91	25.8	0.440	12.48
UPPER STAGE ENGINES (PURPLE LABEL)												
1599	A8-5	4.29	0.56	2.50	5 sec.	2.0/ 56.6	3.00/13.3	0.32 sec.	0.62	17.6	0.110	3.12
1604	B4-6	4.49	1.12	5.00	6 sec.	1.5/ 42.5	3.00/13.3	1.20 sec.	0.78	22.1	0.294	8.33
1607	B6-6	4.49	1.12	5.00	6 sec.	2.0/ 56.6	3.00/13.3	0.83 sec.	0.78	22.1	0.220	6.24
1615	C6-7	5.09	2.25	10.00	7 sec.	2.5/ 70.8	3.00/13.3	1.70 sec.	0.95	26.9	0.440	12.48
BOOSTER ENGINES (RED LABEL)												
1608	B6-0	4.49	1.12	5.00	none	4.0/113.2	3.00/13.3	0.80 sec.	0.58	16.4	0.220	6.24
1616	C6-0	5.09	2.25	10.00	none	4.0/113.2	3.00/13.3	1.68 sec.	0.80	22.7	0.440	12.48

Regular engines are 7 cm (2.75 in.) long and 17.5 mm (0.69 in.) in diameter. Ship Wt. of each package of engines is approximately 113.2 g (4 oz.)
**Series II engines have semi-core-burning grain with large propellant burning area for high initial thrust with short thrust duration.*

MINI ENGINES

SINGLE STAGE ENGINES (GREEN LABEL)

Prod. No.	Engine Type	Prices 4 for	Total Impulse lb.-sec.[1] N-sec.[2]		Time Delay (±15%)	Max. Lift Wt. oz./g	Max. Thrust lb./N	Thrust Duration	Initial Weight oz.	g	Propellant Weight oz.	g
1503	1/2A3-2T	$4.19	0.28	1.25	2 sec.	2/ 56.6	1.75/ 7.8	0.36 sec.	0.198	5.6	0.062	1.75
1507	A3-4T	4.29	0.56	2.50	4 sec.	2/ 56.6	1.75/ 7.8	0.86 sec.	0.268	7.6	0.124	3.50
1511	A10-3T	4.29	0.56	2.50	3 sec.	5/141.5	3.00/13.3	0.26 sec.	0.277	7.9	0.133	3.78
UPPER STAGE ENGINES (PURPLE LABEL)												
1504	1/2A3-4T	4.19	0.28	1.25	4 sec.	1/ 28.3	1.75/ 7.8	0.363 sec.	0.212	6.0	0.062	1.75
BOOSTER ENGINES (RED LABEL)												
1510	A10-0T	4.29	0.56	2.50	none	5/141.5	3.00/13.3	0.26 sec.	0.235	6.7	0.133	3.70

Mini-engines are 4.4 cm (1.75 in.) long and 12.7 mm (0.5 in.) in diameter. Ship Wt. of each package of mini-engines is approximately 70.8 g (2.5 oz.)

'D' ENGINES

SINGLE STAGE ENGINES (GREEN LABEL)

Prod. No.	Engine Type	Prices 3 for	Total Impulse lb.-sec.[1] N-sec.[2]		Time Delay (±15%)	Max. Lift Wt. oz./g	Max. Thrust lb./N	Thrust Duration	Initial Weight oz.	g	Propellant Weight oz.	g
1666	D12-3	$7.79	4.48	20.00	3 sec.	14/396.2	6.4/28.5	1.70 sec.	1.49	42.2	0.879	24.93
1667	D12-5	7.79	4.48	20.00	5 sec.	10/283.0	6.4/28.5	1.70 sec.	1.52	43.1	0.879	24.93
UPPER STAGE ENGINES (PURPLE LABEL)												
1668	D12-7	7.79	4.48	20.00	7 sec.	8/226.4	6.4/28.5	1.70 sec.	1.55	44.0	0.879	24.93
BOOSTER ENGINES (RED LABEL)												
1665	D12-0	7.79	4.48	20.00	none	14/396.2	6.4/28.5	1.70 sec.	1.44	40.9	0.879	24.93
PLUGGED ENGINES for use with R/C rocket gliders **(BLACK LABEL)**												
1669	D11-P	7.79	4.48	20.00	none	16/453.1	6.2/27.6	1.82 sec.	1.55	44.0	0.879	24.93

'D' engines are 7 cm (2.75 in.) long and 24 mm (0.945 in.) in diameter. Ship Wt. of each package of 'D' engines is approximately 184 g (6.5 oz.)

'E' ENGINES

SINGLE STAGE ENGINES (GREEN LABEL)

Prod. No.	Engine Type	Prices 2 for	Total Impulse lb.-sec.[1] N-sec.[2]		Time Delay (±15%)	Max. Lift Wt. oz./g	Max. Thrust lb./N	Thrust Duration	Initial Weight oz.	g	Propellant Weight oz.	g
1680	E15-4	$8.19	7.14	32.00	4 sec.	14/397	4.5/20.5	2.60 sec.	2.00	56.6	1.25	35.5
1682	E15-6	8.19	7.14	32.00	6 sec.	11/312	4.5/20.5	2.60 sec.	2.02	57.3	1.25	35.5
1684	E15-8	8.19	7.14	32.00	8 sec.	9/255	4.5/20.5	2.60 sec.	2.05	58.0	1.25	35.5
PLUGGED ENGINES for use with R/C rocket gliders **(BLACK LABEL)**												
1686	E15-P	8.19	7.59	34.00	none	15/425	4.5/20.5	2.60 sec.	2.12	60.0	1.31	37.2

'E' engines are 8.9 cm (3.5 in.) long and 24 mm (0.945 in.) in diameter. Ship Wt. of each package of 'E' engines is approximately 200g (7.0 oz.)

Complete instructions, igniters and igniter plugs are included with each package of Estes model rocket engines.

[1] Pound-seconds (Figures shown are optimum)

[2] Newton-seconds* (Figures shown are optimum)

* A Newton is the measurement of force required to move one kilogram of mass one meter per second per second. 1 Newton = 0.2248 pounds

ESTES MODEL ROCKET ENGINES HAVE BEEN PROVEN CONSISTENT AND RELIABLE IN MORE THAN 300,000,000 LAUNCHES!

ACCESSORIES

BLAST-OFF™ FLIGHT PACK
EST 1672
$31.99

BLAST-OFF™ FLIGHT PACK
This great assortment of engines features 24 of our most popular engines included in the flight pack are 30 igniters plus a package of recovery wadding - an outstanding deal! The engines include six each of the A8-3, B6-4, C6-5 and C6-7 (upper stage engines, but also ideal for lightweight single stage rockets) engines. Includes 24 igniter plugs too!
Ship Wt: 679 g (1 lb. 8 oz.)

RECOVERY WADDING
EST 2274
$2.69

RECOVERY WADDING
Flame resistant recovery wadding protects your recovery system from hot gases at ejection to ensure reliable deployment. Handy package contains 75 squares - enough for about 25 flights. Instructions for use are printed on the package.
Ship Wt.: 170 g (6 oz.)

IGNITERS
EST 2301
$2.69

IGNITERS
Dependable, easy-to-use Estes igniters in a convenient six-pack. It's always a good idea to keep a few spares around! Used with our new igniter plugs, the safest and most reliable ignition system available.
Ship Wt. 28 g (1 oz.)

COMMAND CONTROL™

This is it - the ultimate launch controller! Take command of your next launch. With NiCad batteries and heavy-duty launch cable, the Command Control™ can pour out enough current to ignite three or four-engine clusters as fast as you can push the button! Loaded with safety features and built to last.

COMMAND CONTROL™ LAUNCH CONTROLLER
EST 2234
$42.79

- Audio and visual continuity indication
- LED voltage readout
- Super safe two-button launch system **plus** safety key
- Built-in igniter storage compartment
- Comes with 9.14 cm (30 feet) of heavy duty launch cable; winding and storage spool; and clip-whip cluster igniter connector
- Uses one or two 6 cell 7.2 volt hobby NiCad battery packs for power (not included - available at your local hobby dealer)
- The launch controller for all your model rocket launches

POWER PLEX™ LAUNCH PAD

Designed for our big Pro™ Series models, this versatile and rugged pad can handle **any** size model rocket since it accepts 3 mm (1/8"), 5 mm (3/16") and 6 mm (1/4") launch rods. Ultra-wide 102 cm (40") footprint plus feet that may be staked down ensure positive stability. Easy trajectory adjustment up to 30° from vertical in any direction. Folds up for convenient transport and storage. 6 mm (1/4") x 122 cm (48") two-piece launch rod, stainless steel blast deflector and stand-off included.

POWER PLEX™ LAUNCH PAD
EST 2235
$69.49

E2™ LAUNCH CONTROLLER
EST 2236
$26.79

- *A New Level of Safety!*

E2™ LAUNCH CONTROLLER

A two-fisted approach to launch rockets. Once the safety key is inserted, you get a red flashing visual and a beeping audio confirmation of continuity. The left button gets pushed to initiate or arm the E2™ and then, keeping the left button pushed, the right button is pushed to launch - the high-tech yet simple approach to maximum launch safety. The E2™ provides plenty of power for many launches with four "C" cells or one 7.2 volt R/C car-type battery (batteries not included). There is also built-in storage for the five meter (15 feet) igniter leads. Do not use for clustering - use the Command Control™ (EST 2234)

TRANSROC II™ ROCKET LOCATOR
EST 2237
$31.99

- *Now You Can Find Your Rocket or Anything Else Too!*

TRANSROC II™

Recovery is easy with this compact, lightweight sonic tracking and locating system for model rockets. The on-board unit fits in any BT-20 size rocket or larger and emits a strong locator tone. The direction and frequency sensitive hand-held receiver will pinpoint the sending unit at up to 183 meters (600 feet) range. Includes headset and magnetic compass. Requires one 9 volt and one 6 volt (type 2CR1/3N) battery - not included.

ELECTRON BEAM® LAUNCH CONTROLLER

The nerve center of any model rocket launch is found in a safe electrically controlled launch system. It puts you in control! You decide when to proceed with countdown and liftoff or whether you need to put your launch on hold. The Electron Beam® features 5.18 meters (17 feet) of launch wire with micro-clips for easy igniter hookup, a safety key to complete the electrical circuit, a continuity light to tell you that you have a complete circuit and a launch push button to commence your launch. The launch controller fits easily in your hand, has a snap-open battery compartment and self-adhesive decals. Requires 4 AA alkaline batteries - not included. Use only with Estes igniters (EST 2301). Use only our Command Control™ (EST 2234) system for clustering engines.

Specifications:
Length: 17.1 cm (6.75"); Width: 38 mm (1.5"); Depth: 31.8 mm (1.25"); Ship Wt. 266 g (8 oz.)

ELECTRON BEAM® LAUNCH CONTROLLER
EST 2220
$20.29

ELECTRON BEAM®/ PORTA-PAD® II COMBO
EST 2218
$28.89

PORTA-PAD® II LAUNCH PAD
EST 2215
$16.99

PORTA-PAD® II LAUNCH PAD

The perfect launch pad for small to medium-sized rockets (models that weigh 500 g (1 lb.) or less). The bright easy-to-see Porta-Pad® II features easy setup and quick takedown, stable design and an easy - no tools required - tilt adjustment (cannot be tilted more than 30° from vertical) for air direction.

The Porta-Pad® II also includes:

- A steel blast deflector plate with sturdy standoff attachment that is screwed onto the plate
- A two-piece, 3 mm (1/8") dia., 81 cm (32") long launch rod. The Porta-Pad® II can also accommodate the optional (not included) 5 mm (3/16") dia. Maxi™ Rod (required for most "D"-powered rockets). If you require a system that has a 6.5 mm (1/4") dia. rod, then please see our Power Plex™ launch pad (EST 2235).
- A safety key and launch rod cap that fits the Electron Beam® and E2™ Launch Controller is included.

Ship Wt.: 680 g (24 oz.)

5 mm (3/16") Dia. Two-Piece Maxi™ Rod
Ship Wt. 340 g (12 oz.) EST 2244 $6.99

3 mm (1/8") Dia. Two-Piece Launch Rod
Ship Wt. 170 g (6 oz.) EST 2243 $4.79

Launch Rod Safety Cap with Safety Key
(will not fit the Command Control™)
Ship Wt. 113 g (4 oz.) EST 2205 $1.59

Micro-Clips (2 per package)
Ship Wt. 28 g (1 oz.) EST 2247 $2.19

Blast Deflector Plate with Standoff
Ship Wt. 142 g (5 oz.) EST 2241 $3.19

Makes Rocket Building Easy!

New!

ROCKET BUILDER'S MARKING GUIDE™
EST 2227
$4.99

Customize Your Rockets!

DECAL PACKS
EST 2995, 2996, 2997
$1.99 EACH

New!

ROCKET BUILDER'S MARKING GUIDE™

This hi-tech plastic tool set is indispensable for both the experienced and rookie modeler. The Rocket Builder's Marking Guide makes it easy to mark fins (three fins at 120° apart, and four fins at 90° apart) and launch lug placement on almost any Estes body tube. The tool set also includes a multi-faceted angled ruler. It can measure (inches and metric), has a special pencil holder to mark tube circumference and a fin-gluing jig for fins (up to 3 mm thick). The angle is the ideal tool to mark fin and launch lug lines down any body tube. A special slide mechanism holds the tube in place. There's no end to what it can do!

Includes: Two "stacked disks" for fin and launch lug marking: One for BT-5, BT-50, and BT-60 tubes and the other fits BT-20, BT-55, and BT-80 tubes; angled ruler; decals, and complete instructions.

DECAL PACKS

Apply these boldly colored, graphically-designed decals anywhere—Estes rockets, model cars, airplanes, notebooks, skateboards—you name it!

Assortment One has water transferable body tube wraparounds (EST 2995)

Assortment Two features water transferable decals with U.S. flags, military "Stars and Bars", letters and numbers, patriotic symbols (EST 2996)

Assortment Three includes self-adhesive chrome foil decals with hatches, cockpits, and fin and body tube decorations (EST 2997)

DESIGNER'S SPECIAL™
EST 1463
$39.59

DESIGNER'S SPECIAL™
Turn your imagination into reality! This comprehensive parts assortment contains everything you need to build up to eight rockets of your own design. Over 75 pieces at excellent savings!
Ship Wt. 0.91 kg (2 lb.)

The Designer's Special contains:
Body Tubes: 2 BT-5, 2 BT-20, 2 BT-50, 1 BT-55, 1 BT-60. Nose Cones: 1 BNC-5E, 1 BNC-5S, 1 BNC-20B, 1 BNC-20R, 1 BNC-50KA, 1 BNC-50YP, 1 BNC-55AC, 1 BNC-60MS. Fin Material: 2 BFS-20, 2 BFS-30, 2 BFS-40. Parachutes: 3 PK-12, 1 PK-18, 1 PK-24. Recovery Equipment: 3 Shock Cords 3 mm (1/8") x 46 cm (18"), 1 Shock Cord 3 mm (1/8") x 91 cm (36"), 1 Shock Cord 6 mm (1/4") x 46 cm (18"), 1 Streamer Material 25 mm (1") x 76 cm (30"), 6 Screw Eyes. Miscellaneous: 3 Engine Blocks (EB-29A), 3 Engine Holders (EH-3), 3 Engine Holder (EH-2), 1 Engine Mount (EH-2050), 1 Engine Mount (EH-2060), 1 Nose Block (NB-20), 1 Nose Block (NB-50), 1 Stage Coupler (JT-55C), 1 Stage Coupler (JT-60C), 1 Balsa Adapter (TA-2050A), 1 Multi-Purpose Paper Adapter Set (TA-1), 12 Launch Lugs - 6 cm (2-3/8") long, 1 Atomic Book of Model Rocketry, 1 Fin Pattern Sheet No. 2, 1 Fin Pattern Sheet No. 3

EMERGENCY REPAIR KIT
EST 2233
$6.79

EMERGENCY REPAIR KIT
Tuck this away in your range box and you'll have many of the things you need to field-repair your model rockets. The reclosable pouch contains these items:

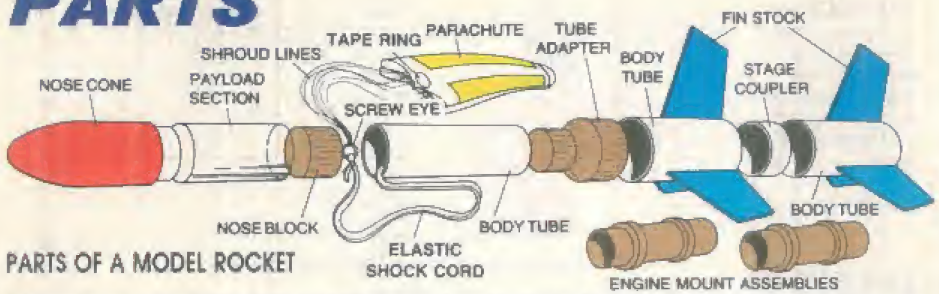
- Sandpaper
- Screw Eyes
- White Glue
- Shock Cord Mounts
- Tape Rings
- Launch Rod Safety Cap
- Micro-Clips
- Universal Safety Key
- Recovery Wadding
- 30 cm (12") Parachute
- 366 mm (144") Shroud Line
- Launch Lugs
- 3 mm (1/8") & 6 mm (1/4") Elastic Shock Cords

Ship Wt. 226 g (8 oz.)

FIN ALIGNMENT GUIDE
EST 2231
$17.69

FIN ALIGNMENT GUIDE
This useful tool will allow you to position and glue 2 mm (3/32") and 3 mm (1/8") thick fins quickly and easily. Designed to fit body tubes up to a BT-101, three or four-finned designs, aligning the fins at 90° or 120° to each other. Assembles easily with slip-together plastic parts. Adjusts quickly with plastic fin position clips.
Ship Wt.: 1358 g (3 lbs.)

PARTS



PARTS OF A MODEL ROCKET

Model rocket kits are constructed of lightweight materials such as balsa wood, paper tubes, and plastic as shown in this diagram. Nearly all matching Estes parts have the same series description number and are interchangable. For instance, a body tube BT-20 will mate with a balsa nose cone BNC-20B. A balsa adapter TA-2060 will adapt a BT-20 to a BT-60. An AR-2050 will center a BT-20 in a BT-50. When ordering parts, use both the product number and the description.

BODY TUBES: Spiral wound paper. Use stage couplers to connect tubes of the same diameter. Use balsa adapters to transition from one tube size to another.

Prod. No.	Description	Price Each	Length in./cm	Inside Dia. in./mm	Outside Dia. in./mm	Wall Thick. in./mm	Weight (oz./g) Net	Ship.
30302	BT-5	$2.32	18.0/45.7	0.518/13.2	0.544/ 13.8	.013/.33	0.219/ 6.2	1/312
30316	BT-20	2.70	18.0/45.7	0.710/18.0	0.736/ 18.7	.013/.33	0.288/ 8.2	1/312
30352	BT-50	2.70	18.0/45.7	0.950/24.1	0.976/ 24.8	.013/.33	0.378/10.7	1/312
30382	BT-55	3.08	18.0/45.7	1.283/32.6	1.325/ 33.7	.021/.53	0.672/19.1	1/312
30396	BT-60	3.35	18.0/45.7	1.595/40.5	1.637/ 41.6	.021/.53	0.960/27.2	1/312
30424	BT-70	2.07	17.5/44.5	2.180/55.4	2.217/ 56.3	.021/.53	1.300/36.9	14/397
30433	BT-80KD	1.90	14.2/36.1	2.588/66.0	2.600/ 66.0	.021/.53	0.637/18.1	1/312
30449	BT-101SV	6.42	24.7/62.7	3.896/99.0	3.938/100.0	.021/.53	2.873/81.4	16/454

NOSE CONES: Please note that a BNC is a balsa nose cone while PNC refers to a plastic nose cone.

Shape	No.	Prod. No.	Description BNC=Balsa PNC=Plastic	Price Each	Average Dimensions (in./mm) 1	2	3	Ship. Wt. (oz./g)	Wt. (oz. /g)
1 2 3 4	1	70216	BNC-5V	$2.36	0.750/ 19.1	0.544/13.8	0.250/ 6.4	0.013/ 0.4	1/ 28
	2	70212	BNC-5E	2.36	1.375/ 34.9	0.544/13.8	0.250/ 6.4	0.020/ 0.6	1/ 28
	3	70214	BNC-5S	2.36	1.500/ 38.1	0.544/13.8	0.250/ 6.4	0.016/ 0.5	1/ 28
	4	70218	BNC-5W	2.70	2.800/ 71.1	0.544/13.8	0.250/ 6.4	0.039/ 1.1	2/ 57
5 6 7 8	5	70230	BNC-20B	$2.56	1.700/ 43.2	0.736/18.7	0.500/12.7	0.050/ 1.4	1/ 28
	6	70240	BNC-20R	2.70	2.750/ 69.9	0.736/18.7	0.500/12.7	0.070/ 2.0	2/ 57
	7	70226	BNC-20AM	2.62	2.000/ 50.8	0.736/18.7	0.500/12.7	0.060/ 1.7	2/ 57
	8	70241	BNC-20Y	2.49	0.950/ 24.1	0.736/18.7	0.500/12.7	0.020/ 0.6	1/ 28
9 10 11 12	9	70256	BNC-50J	$2.70	1.370/ 34.8	0.976/24.7	0.500/12.7	0.080/ 2.3	4/113
	10	70262	BNC-50K	2.95	2.750/ 69.9	0.976/24.7	0.500/12.7	0.130/ 3.7	4/113
	10	71028	PNC-50KA	2.39	2.735/ 69.5	0.976/24.7	0.750/19.1	0.130/ 3.7	4/113
	11	71001	PNC-50SP	3.54	4.720/119.9	0.976/24.7	0.500/12.7	0.250/ 7.1	6/170
	12	70266	BNC-50Y	3.54	4.350/110.5	0.976/24.7	0.500/12.7	0.160/ 4.5	6/170
13 14	13	71070	PNC-55AC	$4.13	5.403/137.2	1.325/33.7	0.500/12.7	0.320/ 9.1	6/170
	14	71038	PNC-55D	4.13	3.750/ 95.3	1.325/33.7	0.750/19.1	0.360/10.2	4/113
15 16	15	71020	PNC-60MS	$3.62	2.500/ 63.5	1.637/41.6	0.750/19.1	0.390/11.1	4/113
	16	71043	PNC-60AH	5.19	6.750/171.5	1.637/41.6	0.800/20.3	1.000/28.4	6/170
17	17	70300	BNC-70AJ	$5.78	4.440/111.8	2.217/56.3	0.750/19.1	0.850/24.1	6/170
18 19	18	71035	PNC-80K	$5.38	8.150/207.0	2.600/66.0	1.000/25.4	1.680/47.6	8/227
	19	72080	PNC-80BB	5.38	4.000/101.6	2.600/66.0	1.750/44.5	1.180/33.5	8/227

FIN STOCK: Top quality balsa sheeting for making fins. Remember that the leading edge of the fin needs to be parallel to the grain of the wood.

Prod. No.	Description	Price 3 for	Dimensions (in./mm)	Weight in oz./g Net	Ship.	Major Use
32102	BFS-20	$2.33	0.063x3x 9/ 1.6x76.2x228.6	0.13/3.7	4/113	High Performance
32106	BFS-20L	2.65	0.063x3x12/ 1.6x76.2x304.8	0.17/4.8	6/170	High Performance
32108	BFS-30	2.39	0.094x3x 9/ 2.4x76.2x228.6	0.15/4.3	4/113	SportModels
32110	BFS-30L	2.70	0.094X3x12/ 2.4X76.2x304.8	0.20/5.7	6/170	Sport Models
32116	BFS-40	2.46	0.125x3x 9/ 3.2x76.2x228.6	0.20/5.7	4/113	Cluster Rockets
32118	BFS-40L	2.70	0.125x3x12/ 3.2x76.2x304.8	0.27/7.5	6/170	Glider Wings

ENGINE MOUNTS: These high performance engine mount kits are great for all your original designs. All engine mount kits are easy to assemble, have detailed instructions and lightweight components. The EM-520 is great for a quick change conversion for flying mini-engines in lightweight regular-size engine rockets and the EM-2050 is perfect for using regular-size engines in lightweight "D" rockets. Check engine charts to insure that maximum liftoff weights are not exceeded. Avg. Ship Wt. 141.75 g (5 oz.)

Engine Type	Prod. No.	Description	Price	Fits	Net Weight oz./g
For Regular Engines-A, B, & C type, 0.69" x 2.75"	3150 3151 3152	EH-2050 EH-2055 EH-2060	$2.63 2.63 2.63	BT-50 BT-55 BT-60	0.10/2.8 0.14/4.0 0.17/4.8
For "1" Mini-Engines, .5" x 1.75"	3153	EM-520	$2.56	BT-20	0.09/2.6
Special Purpose Quick-Change Conversion Mount-from "D" Engines to Regular Engines	3154	EM-2050	$2.70	BT-50	0.19/5.4
For "D" type Engines, 0.945" x 2.75"	3156	EM-2055/60	$3.49	BT-55 or BT-60	0.30/8.5

ENGINE BLOCKS: Fits inside a BT-20 engine or body tube. Use with or without an engine hook to create a thrust bulkhead. Description - EB-20A, Wt. 0.3 g (0.009 oz.). Ship Wt. 28 g (1 oz.)

EST 3131 $2.17

ENGINE HOLDER: Flat steel spring with an easy-to-use design allows an engine to be easily inserted, removed, and securely held in an engine tube. 3 per package. Ship Wt. 28 g (1 oz.)

For regular and "D" engines

EST 3140 $3.01

For mini-engines

EST 3142 $2.62

MULTI-PURPOSE RING SET: This set has 20 total rings for centering and mounting BT-5 in BT-20; BT-5 and BT-20 in BT-50; and BT-5, BT-20 and BT-50 in BT-60. Also includes three universal adapter shrouds with instructions. This set is great for that special design. Ship Wt. 57 g (2 oz.)

EST 85013 $2.62

CENTERING RINGS - AR-2050: Extra-strong centering rings that center a BT-20 tube in a BT-50 tube. Perfect for custom engine mounts. Weight per pair is 8.1 g (0.285 oz.) 10 per package. Ship Wt. 57 g (2 oz.)

EST 3100 $3.01

CENTERING RINGS - AR-5055: Extra-strong centering rings that center a BT-50 tube in a BT-55. Perfect for "D" engine mounts. Wt. 1.8 g (0.062 oz.) 4 per package. Ship Wt. 57 g (2 oz.)

EST 3102 $2.56

RING ADAPTERS: These card rings will center and mount a BT-20 tube into the given outer tube. Ship Wt. 57 g (2 oz.)

Product Number	Description	Outer Tube	No. per Package	Price per Package
EST 3110	RA-2050	BT-50	20	$2.36
EST 3111	RA-2055	BT-55	10	2.43
EST 3113	RA-2060	BT-60	10	2.56

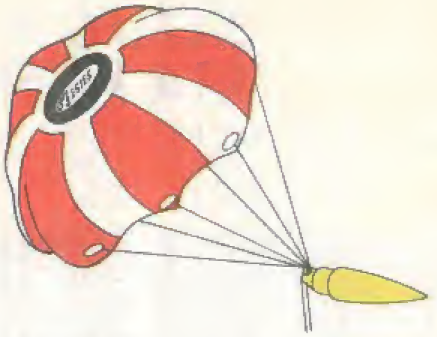
BALSA ADAPTER: Smoothly taper from one size body tube to another. Great for payload capsules, parachute compartments or creating unique looking rockets. Can be hollowed out for ejection gas passage. Both ends on all adapters have at least 13 mm (1/2") mating surface.

Prod. No.	Description	Price Each	Mates Tubes	Length in./mm	Taper Len. in./mm	Weight in oz./g Net	Ship.
70002	TA-520	$2.56	BT-5 to BT-20	1.8/44.5	0.8/19.1	0.04/ 1.13	1/ 28
70004	TA-550	2.70	BT-5 to BT-50	2.2/55.9	1.0/25.4	0.06/ 1.70	4/113
70006	TA-2050	2.36	BT-20 to BT-50	3.0/76.2	2.0/50.8	0.15/ 4.25	4/113
70010	TA-2055	2.89	BT-20 to BT-55	2.5/63.5	1.5/38.1	0.22/ 6.24	4/113
70012	TA-2060	4.13	BT-20 to BT-60	3.0/76.2	2.0/50.8	0.20/ 5.67	4/113
70014	TA-2055	4.13	BT-50 to BT-55	2.0/50.8	1.0/25.4	0.60/17.01	4/113
70016	TA-5060	4.92	BT-50 to BT-60	3.0/76.2	2.0/50.8	0.23/ 6.52	4/113
70027	TA-5560	5.06	BT-55 to BT-60	2.2/55.9	1.0/25.4	0.25/ 7.09	4/113
70034	TA-6070	4.67	BT-60 to BT-70	2.7/68.6	1.5/38.1	0.65/18.43	4/113

We reserve the right to change packaging contents and quantities.

PARACHUTE KITS

These two-color parachutes give maximum visibility and are very durable, lightweight and easily folded. Each parachute kit comes with 'chute material, tape rings and shroud lines. The Solar™ Chute comes in a silver-coated plastic with red and black markings - great for those futuristic models. Each weighs less than 8.5 g (0.3 oz.)
Ship Wt. 57 g (2 oz.)



Product Number	Description	Parachute Diameter (cm/in.)	Price Each
2264	PK-12	30/12	$2.89
2267	PK-18	45/18	$3.19
2271	PK-24	61/24	$3.19
2272	PK-18 (Solar Chute™)	45/18	$3.19

SHOCK CORDS: Strong, long-lasting elastic shock cords. Specify width and length when ordering. Ship Wt. 28 g (1 oz.) 3 mm (1/8") wide, 45 cm (18") long. Net Wt. 1.1 g (0.039 oz.)

EST 2276 $1.39

6 mm (1/4") wide, 90 cm (36") long. Net Wt. 2.2 g (0.078 oz.)

EST 38382 $1.57

6 mm (1/4") wide, 45 cm (18") long. Net Wt. 2.2 g (0.078 oz.)

EST 2277 $1.52

TAPE RINGS: Fasten shroud lines to plastic parachutes or streamers with these 19 mm (3/4") diameter extra adhesive vinyl pressure sensitive tape rings. In sheets of 6 rings (4 sheets per package). Ship Wt. 28 g (1 oz.)

EST 2294 $2.36

TAPE STRIPS: These strips have high strength and are ideal for fastening shroud lines. Dimensions of each strip are 6.4 mm (1/4") x 19.1 mm (3/4"). 12 strips per sheet, 6 sheets per package. Ship Wt. 28 g (1 oz.)

EST 38412 $2.52

STREAMER MATERIAL: Bright orange, flame-resistant crepe paper makes great high performing streamers. Comes in 229 cm (7-1/2 foot) lengths - enough for two to eight streamers. Specify size when ordering. Ship Wt. 28 g (1 oz.)

25.4 mm wide (1"). Net Wt. 2.7 g (0.092 oz.)

EST 2341 $4.07

50.8 mm wide (2"). Net Wt. 5.2 g (0.184 oz.)

EST 2343 $4.40

SNAP SWIVELS: Allows for quick changes between recovery systems. It also reduces the tangling in parachutes. These swivels are 25.4 mm (1") long and come 12 to a package. Net Wt. 0.3 g (0.01 oz.) Ship Wt. 28 g (1 oz.)

EST 2292 $3.00

SHROUD LINES: Strong shroud line cord for your custom parachutes. Comes in a 64 meter (210 foot) spool. Ship Wt. 142 g (5 oz.)

EST 2340 $2.36

SCREW EYES: Attach your shock cords and recovery systems to balsa nose cones, nose blocks and adapters with these screw eyes. Specify size when ordering (6 per package). Ship Wt. 28 g (1 oz.)

LARGE EYE, perfect for BT-55 and above. 25.4 mm (1") long. Wt. 1.1 g (0.04 oz.)

EST 2280 $2.23

SMALL EYE, great for BT-20 and above. 19.1 mm (3/4") long. Wt. 0.9 g (0.03 oz.)

EST 2279 $2.10

EXTRA SMALL EYE, for BT-5 and BT-20. 15.99 mm (5/8") long. Wt. 0.3 g (0.01 oz.)

EST 2281 $1.78

DOWELS: Extra strong, lightweight seasoned maple dowels. 8 per package. Specify size when ordering. Ship Wt. 142 g (5 oz.)

3 mm (1/8") x 45 cm (18")

EST 3190 $2.03

2 mm (1/12") x 30 cm (12")

EST 3191 $2.03

LAUNCH LUGS: High-strength laminated lugs with a mylar plastic core for durability and a paper outer layer for easy gluing

Product Number	Length	No. per Package	Price per Package
For 3 mm (1/8") rods:			
EST 2321	31.8 mm (1.25")	12	$2.45
EST 2322	60.3 mm (2.38")	10	$2.89
For 5 mm (3/16") rods - Maxi™ Rods:			
EST 2328	50.8 mm (2.00")	4	$2.36

STAGE COUPLERS: Use for multi-staging, joining body tubes, making engine mounts, etc. Also makes perfect guides for cutting body tubes. Ship Wt. for all is 0.9 g (0.3 oz.) each.

Prod. No.	Description	Price Each	Outside Dia. in./mm	Inside Dia. in./mm	Length in./mm	Fits	Avg. Wt. oz./g
30252	JT-5C	$1.57	0.51/13.0	0.46/11.6	0.75/19.1	BT-5	0.02/0.6
30254	JT-20C	1.57	0.71/18.0	0.65/16.5	0.75/19.1	BT-20	0.03/0.8
30260	JT-50C	1.57	0.95/24.1	0.92/23.4	1.00/25.4	BT-50	0.05/1.5
30262	JT-55C	1.57	1.28/32.5	1.25/31.8	1.30/33.0	BT-55	0.09/2.5
30266	JT-60C	1.57	1.59/40.4	1.56/40.4	1.50/38.1	BT-60	0.12/3.5
30270	JT-70A	2.36	2.16/55.2	2.12/53.7	1.25/31.8	BT-70	0.14/4.0
30274	JT-80C	2.36	2.56/65.1	2.50/63.6	1.00/25.4	BT-80	0.10/2.9
30280	JT-101SV	2.36	3.89/98.8	3.85/97.7	1.38/34.9	BT-101	0.18/5.2

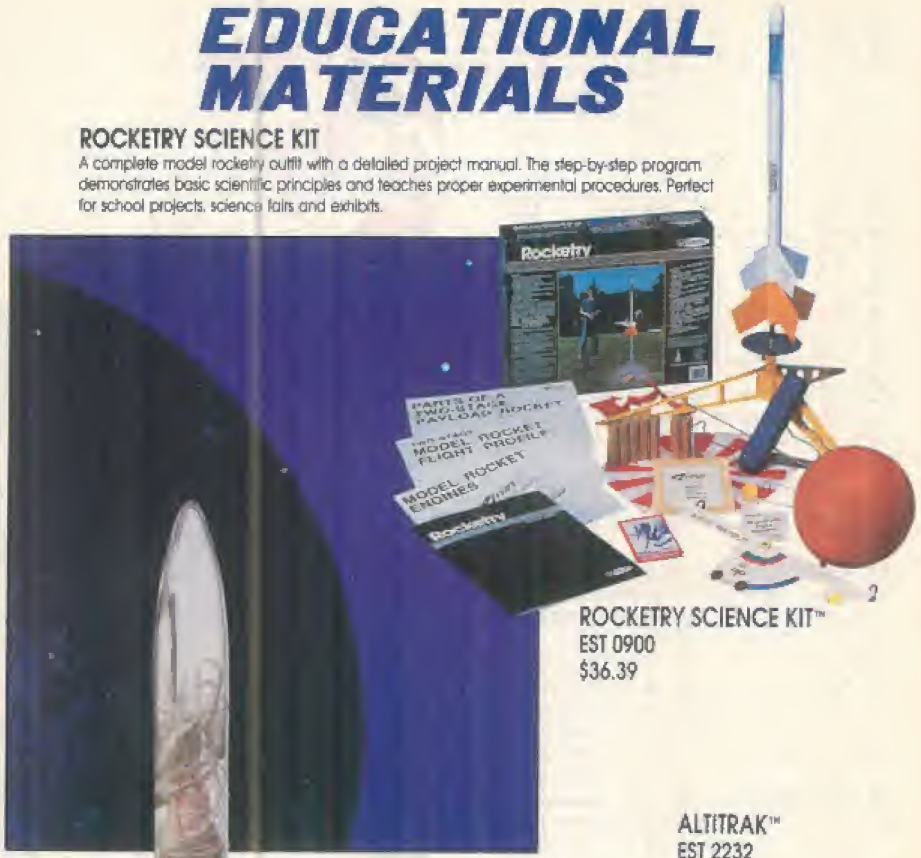
NOSE BLOCKS: Use nose blocks to partition off payload sections or anywhere else a solid bulkhead is required.

Prod. No.	Description	Price Each	Outside Dia. (in./mm)	Length (in/mm)	Fits	Weight (oz./g) Net	Ship.
70152	NB-20	$1.72	0.71/18.0	0.75/19.1	BT-20	0.014/3.97	1/ 28
70158	NB-50	1.93	0.95/24.1	1.00/25.4	BT-50	0.040/1.13	4/113

EDUCATIONAL MATERIALS

ROCKETRY SCIENCE KIT

A complete model rocketry outfit with a detailed project manual. The step-by-step program demonstrates basic scientific principles and teaches proper experimental procedures. Perfect for school projects, science fairs and exhibits.



ROCKETRY SCIENCE KIT™
EST 0900
$36.39

PHANTOM™
EST 1207
$7.29

ALTITRAK™
EST 2232
$16.99

ALTITRAK™

How high does it fly? Simply follow your rocket in the sights to its highest point, then release the trigger to lock in the reading. Displays your rocket's height directly in meters and elevation angle in degrees. A meters-to-feet conversion table is included. Use two for even greater accuracy.

IDEA: Compare the results to predictions made with our Aerotrek™ software.
Ship Wt. 425 g (15 oz.)

PHANTOM™

This model rocket will never leave the ground. A non-flying model that is great for demonstrations, science fairs and exhibits. The clear plastic body tube, nose cone and fin unit allow you to see the recovery parachute, engine mount and a static cutaway C6-5.

Specifications:
Length: 32 cm (12.6"); Dia.: 24.8 mm (0.976"); Wt.: 38 g (1.35 oz.)

PUBLICATIONS

MODEL ROCKET NEWS MAGAZINE

Provides articles of interest, technical tips, information about new products, special offers, and much more. Available to ESP members and through local retailers.

★ MODEL ROCKETRY TECHNICAL MANUAL ★

Handy guide for construction and flight of model rockets. Tips on "scratch building", launch systems, tracking, staging, boost-glider, and more.
EST 2819 (Updated & Revised) $.80

ALPHA BOOK OF MODEL ROCKETRY

An informative book for beginners in model rocketry. 32 pages.
EST 2820 $1.20

THE LAWS OF MOTION AND MODEL ROCKETRY

The three laws of motion are explained in easily understood terms. Simple examples and experiments are included. 12 pages.
EST 2821 $.75

ESTES GUIDE FOR AEROSPACE CLUBS

The perfect source book for organizing and operating a successful model rocket club or ESP chapter. 34 pages.
EST 2817 $1.20

MODEL ROCKET CONTEST GUIDE

Plan model rocket contests for clubs or schools. Details on competitive events and suggestions on all facets of contest organization. 18 pages.
EST 2815 $1.20

PROJECTS IN MODEL ROCKETRY

Suggestions on how to plan, prepare, and present research projects, ideas for about one hundred projects.
EST 2831 $.95

THE CLASSIC COLLECTION

A comprehensive collection of technical reports that makes a valuable reference tool.
EST 2845 $3.70

MODEL ROCKETRY STUDY GUIDE

A logical program for anyone who wants the most from model rocketry. Guides a beginner on the path to becoming an expert rocketeer.
EST 2841 $1.55

ALTITUDE PREDICTION CHARTS

A simple system by which aerodynamic drag and other effects can be taken into account in predicting rocket peak altitudes. Technical Report TR-10.
EST 2842 $2.15

AERODYNAMIC DRAG OF MODEL ROCKETS

Gives practical examples of ways to minimize aerodynamic drag and improve performance. Technical Report TR-11.
EST 2843 $2.15

ELEMENTARY MATHEMATICS OF MODEL ROCKET FLIGHT

Information on how to make your own altitude tracker and calculate speeds and accelerations. Technical Note TN-5.
EST 2844 $.90

ESTES EDUCATOR NEWS

Interesting technical articles, new product information, plus activities and resources on space and model rocketry subjects suitable for classroom use. Available through many local retailers.

GUIDE FOR TEACHERS AND YOUTH GROUP LEADERS

Introduces you to Estes' model rocket technology and the complete services offered in our educational program.
EST 2814 $2.15

INDUSTRIAL ARTS TEACHERS MANUAL FOR MODEL ROCKETRY

Practical applications of model rocketry in the study of manufacturing, transportation, R & D, communications and construction. 52 pages.
EST 2810 $1.55

MODEL ROCKET LAUNCH SYSTEMS

Electrical theory of launches is clearly explained, complete with photographs, schematics and study problems. 20 pages.
EST 2811 $.95

CAMP LEADER'S MODEL ROCKETRY MANUAL

Proven guide for introducing model rocketry successfully into camp programs. 10 pages.
EST 2822 $1.55

VIDEO – MODEL ROCKETRY - THE LAST FRONTIER*

Capture the excitement of model rocketry in this full color VHS video presentation, narrated by and featuring William Shatner of Star Trek** fame! An excellent primer to model rocketry with dramatic launch footage and graphic, easy-to-understand illustration. 15 minutes.
EST 2792 $9.99

*Copyright Estes Industries 1989. All Rights Reserved.
** Copyright Paramount Pictures Corporation 1975. All Rights Reserved.

SOFTWARE

ASTROCAD™

Written by Michael Gasperi

This easy-to-use computer program is ideal for basic model rocket performance analysis. This program menu has the following items:

Apogee Determination	Model Rocket Design (two versions)
Drag Prediction	Aerodynamic Stability
Performance Prediction	Optimum Weight
Flight Simulation	Elliptical Fin Design
Apple	**IBM PC (and compatibles)**
EST 9028 $8.49	EST 9037 $8.49

Learn about the principles of aerodynamics, physics, and space flight with these three programs.

PHYSICS OF MODEL ROCKETRY™

Action-reaction-inertia-momentum-acceleration-energy-staging and satellites
EST 9027 $10.89

FLIGHT: AERODYNAMICS OF MODEL ROCKETS™

Forces-aerodynamics-stability-drag-center of gravity-center of pressure
EST 9026 $21.29

IN SEARCH OF SPACE - INTRODUCTION TO MODEL ROCKETRY™

Flight profile-parts-engines and classification-safety code plus bonus program on multi-staging and igniter installation and function
EST 9025 $10.69

CURRICULA

SCIENCE AND MODEL ROCKETS

For Grades 5, 6, 7, & 8

Written by Sylvia Nolte, Ed. D.; Based on Nancy Stoop's Course Outline

- Day-to-day lesson plans with specific goals and objectives
- Excellent for teaching science and mathematics including: Newton's Laws of Motion; Geometry; Principles of Flight; Formula Calculations; Simple Aerodynamics; Graphing
- Includes backgrounds for the educator, overhead transparencies, activity sheets, material requirements and awards for the students

EST 2847 $3.25

PHYSICS AND MODEL ROCKETS

For Grades 8, 9, 10, & 11

Written by Sylvia Nolte, Ed. D.; Edited by Thomas Beach, PhD and Tim Van Milligan, A.E.

- The next logical step after the Science and Model Rockets Curriculum
- A ready-to-use lesson plan describing Newton's Laws of Motion and aerodynamic principles applied to model rockets
- Includes teacher background, student manual with workbook, math extensions, transparencies and activity sheets

EST 2848 $3.25

MATHEMATICS AND MODEL ROCKETS

Written by Sylvia Nolte, Ed. D.; Based on a course by Harold McConnell, PhD

- Take the next step - rocket engineering!
- Explore the interaction between centers of pressure and mass
- Apply mathematics and graphics to rocket design
- Wind tunnel experimentation and evaluation

EST 2849 $3.25

ESTES BULK PACKS

ESTES EDUCATOR

Save with the purchase of economical bulk packs for your group! No fancy packaging! Each rocket pack contains parts to construct 12 rockets plus extra small parts, just in case!

Your students will love creating their own decor on these fun-to-build rockets!

Explorer™ Series Rockets - 12 per bulk pack

Scrambler™ Bulk Pack - See page 31 for description
EST 1759 $125.99

Tornado™ Bulk Pack - See page 26 for description
EST 1758 $35.59

Loadstar™ Bulk Pack - See symbols below
- Advanced two-stage payloader
- Huge clear plastic payload section - fly one or two-stage for performance experiments
- Maximum altitude using C6-0 and C6-7 engines: 305 Meters (1000 ft.)

Specifications:
Length: 62.5 cm (24.625"); Dia.: 41.6 mm (1.637"); Wt. (without payload): 80.1 g (2.83 oz.); Engines: Single Stage - A8-3, B4-4 (First Flight), B6-4, B8-5, C6-5; First Stage - B6-0 (First Flight), C6-0; Second Stage - A8-5 (First Flight), B6-6, B8-6, C6-7
EST 1760 $132.99

Bulk packs are convenient and include everything your students will need to prepare their rockets for flight:

Model Rocket Engine Bulk Packs

Include: 24 rocket engines; 30 model rocket igniters, 24 reusable igniter plugs; 75 - 11.4 cm (4.5") squares of recovery wadding - enough for approximately 25 launches.

1/2A3-2T Bulk Pack	EST 1780 $25.29	B6-4 Bulk Pack	EST 1783 $35.99
A8-3 Bulk Pack	EST 1781 $35.19	B6-0/B6-6 Bulk Pack	EST 1784 $35.99
A8-5 Bulk Pack	EST 1782 $35.19	C5-3 Bulk Pack	EST 1785 $39.99

E2X ® Series Rockets - 12 per bulk pack

Gnome™ Bulk Pack - See page 13 for description
EST 1750 $35.49

Alpha® III Bulk Pack - See page 13 for description
EST 1751 $69.49

Bandit™ Bulk Pack - See page 12 for description
EST 1752 $84.29

Dagger™ Bulk Pack - See page 13 for description
EST 1753 $125.99

Turbo Copter™ Bulk Pack - See page 9 for description
EST 1762 $75.49

Generic E2X™ Bulk Pack - See symbols below
- Super easy to build
- All white - color with markers or paint or leave white!
- Comes with a variety of foil self-stick decals for customizing

Specifications:
Length: 38.1 cm (15"); Dia.: 24.6 mm (0.976"); Wt.: 36 g (1.27 oz.); Engines: A8-3 (First Flight), 1/2A6-2, A8-5, B4-4, B4-6, B6-6, B8-5, C6-5, C6-7
EST 1764 $64.49

New!

New!

Beta ™ Series Rockets - 12 per bulk pack

Performance™ Rocket Bulk Pack - see symbols below
- Students choose balsa fin design
- Boattail option
- Technical reports on stability and tracking
- Includes altitude tracker for performance comparison

Specifications:
Dia.: 24.6 mm (0.976"); Length and weight will vary with chosen design. Engines: A8-3 (First Flight), 1/2A6-2, A8-5, B4-4, B4-6, B6-6 B8-5, C6-5, C6-7
EST 1765 $86.99

Altitude varies with rocket

Viking™ Bulk Pack - See page 20 for description
EST 1755 $31.59

Alpha® Bulk Pack - See page 20 for description
EST 1756 $59.89

Wizard™ Bulk Pack - See page 19 for description
EST 1754 $39.99

Nova Payloader™ Bulk Pack - See page 23 for description
EST 1757 $99.99

ESTES EDUCATOR

Supplies for school classes and youth groups

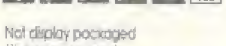
ESTES TEACHER'S STARTER SET

Demonstrate to yourself and your students the power of educational model rocketry
- Designed specifically for the educator just beginning model rocketry studies
- Become familiar with Estes model rocket technology and then use the enclosed booklets to introduce your students to the excitement of hands- on learning!

Skill Level 1

Set contains:
- Big Bertha™ two feet tall single engine demonstration rocket, parachute recovery
- Glue, sandpaper, and razor blade to build the Big Bertha™*
- Electron Beam® control system**
- Porta-Pad® II launch pad**
- Engines, recovery wadding, igniters and plugs included - enough for six launches
- Teachers and Youth Group Leaders Guide
- Science and math applications using model rocketry
- Estes catalog

EST 1456 $34.99



Not display packaged
*Paint not included
**The Electron Beam® and the Porta-Pad® II can be used to launch most rockets shown in this catalog except Pro™ Series and Estes R/C.
4 AA alkaline batteries not included

SPECIAL OFFERS

EXPLORER™ SERIES

NATIONAL AEROSPACE PLANE™

EST 2037 ~~$16.79~~ $10.99

An early concept of what the proposed U.S. hypersonic, "runway to orbit" test vehicle would look like. Our rocket is molded with scram/ram engine ducts, three-color decal, and parachute recovery.

Specifications:
Length: 67.3 cm (26.5"); Dia.: 41.6 mm (1.637"); Wt.: 97.9 g (3.46 oz.); Engines: A8-3 (First Flight), B4-4, B6-4, B8-5, C6-5

DEEP SPACE TRANSPORT™

EST 2034 ~~$18.59~~ $13.99

Futuristic model of an interplanetary passenger/cargo vehicle. This rocket features a unique nose cone, tri-body design and a large three-color decal.

Specifications:
Length: 67.3 cm (26.5"); Dia.: 33.7 mm (1.325"); Wt.: 106.1 g (3.75 oz.); Engines: B4-2 (First Flight), B6-2, C5-3, C6-3

NAR SAFETY CODE

(Effective 10-91)

1. **Materials**—My model rocket will be made of lightweight materials such as paper, wood, rubber, and plastic suitable for the power used and the performance of my model rocket. I will not use any metal for the nose cone, body, or fins of a model rocket.
2. **Motors/Engines**—I will use only commercially-made NAR certified model rocket engines in the manner recommended by the manufacturer. I will not alter the model rocket engine, its parts, or its ingredients in any way.
3. **Recovery**—I will always use a recovery system in my model rocket that will return it safely to the ground so it may be flown again. I will use only flame resistant recovery wadding if required.
4. **Weight and Power Limits**—My model rocket will weigh no more than 1,500 grams (53 ounces) at liftoff, and its rocket engines will produce no more than 320 Newton-seconds (4.45 Newtons equal 1.0 pound) of total impulse. My model rocket will weigh no more than the engine manufacturer's recommended maximum liftoff weight for the engines used, or I will use engines recommended by the manufacturer for my model rocket.
5. **Stability**—I will check the stability of my model rocket before its first flight, except when launching a model rocket of already proven stability.
6. **Payloads**—Except for insects, my model rocket will never carry live animals or a payload that is intended to be flammable, explosive, or harmful.
7. **Launch Site**—I will launch my model rocket outdoors in a cleared area, free of tall trees, power lines, buildings, and dry brush and grass. My launch site will be at least as large as that recommended in the following table.

LAUNCH SITE DIMENSIONS

Installed Total Impulse (Newton-Seconds)	Equivalent Engine Type	Minimum Site Dimension (feet)	(meters)
0.00– 1.25	¼A & ½A	50	15
1.26– 2.50	A	100	30
2.51– 5.00	B	200	60
5.01– 10.00	C	400	120
10.01– 20.00	D	500	150
20.01– 40.00	E	1000	300
40.01– 80.00	F	1000	300
80.01–160.00	G	1000	300
160.01–320.00	2Gs	1500	450

8. **Launcher**—I will launch my model rocket from a stable launch device that provides rigid guidance until the model rocket has reached a speed adequate to ensure a safe flight path. To prevent accidental eye injury, I will always place the launcher so the end of the rod is above eye level or I will cap the end of the rod when approaching it. I will cap or disassemble my launch rod when not in use, and I will never store it in an upright position. My launcher will have a jet deflector device to prevent the engine exhaust from hitting the ground directly. I will always clear the area around my launch device of brown grass, dry weeds, or other easy-to-burn materials.
9. **Ignition System**—The system I use to launch my model rocket will be remotely controlled and electrically operated. It will contain a launching switch that will return to "off" when released. The system will contain a removable safety interlock in series with the launch switch. All persons will remain at least 15 feet (5 meters) from the model rocket when I am igniting model rocket engines totalling 30 Newton-seconds or less of total impulse and at least 30 feet (9 meters) from the model rocket when I am igniting model rocket engines totalling more than 30 Newton-seconds of total impulse. I will use only electrical igniters recommended by the engine manufacturer that will ignite model rocket engine(s) within one second of actuation of the launching switch.
10. **Launch Safety**—I will ensure that people in the launch area are aware of the pending model rocket launch and can see the model rocket's liftoff before I begin my audible five-second countdown. I will not launch a model rocket using it as a weapon. If my model rocket suffers a misfire, I will not allow anyone to approach it or the launcher until I have made certain that the safety interlock has been removed or that the battery has been disconnected from the ignition system. I will wait one minute after a misfire before allowing anyone to approach the launcher.
11. **Flying Conditions**—I will launch my model rocket only when the wind is less than 20 miles (30 kilometers) an hour. I will not launch my model rocket so it flies into clouds, near aircraft in flight, or in a manner that is hazardous to people or property.
12. **Pre-Launch Test**—When conducting research activities with unproven model rocket designs or methods I will, when possible, determine the reliability of my model rocket by pre-launch tests. I will conduct the launching of an unproven design in complete isolation from persons not participating in the actual launching.
13. **Launch Angle**—My launch device will be pointed within 30 degrees of vertical. I will never use model rocket engines to propel any device horizontally.
14. **Recovery Hazards**—If a model rocket becomes entangled in a power line or other dangerous place, I will not attempt to retrieve it.

As a member of the Estes Model Rocketry Program, I promise to faithfully follow all rules of safe conduct as established in the above code.

Signed _____ Date _____

This is the official Model Rocketry Safety Code of the National Association of Rocketry and the Model Rocket Manufacturers Association.

Estes Note: The largest "model" rocket engine as defined by CPSC is an "F" (80 NS). To launch rockets weighing over one pound including propellant or rockets containing more than 4 oz. of propellant (net weight), you must obtain a waiver from the FAA. Check your telephone directory for the FAA office nearest you.

RCHTA RADIO CONTROL HOBBY TRADE ASSOCIATION

MEMBER HOBBY MANUFACTURERS OF AMERICA

NAR

INDEX

FULL ONE YEAR WARRANTY

Your Estes product is warranted against defects in materials or workmanship for one year from the date of its original purchase. Any Estes product, except computer software, which, because of a manufacturing defect, malfunctions or proves to be defective within the one-year warranty period will be replaced or replaced, at Estes' option and at no charge to you, provided it is returned to Estes with proof of purchase.

This warranty does not cover incidental or consequential damage to persons or property caused by the use, misuse, misuse, failure to comply with operating instructions or improper storage of the warranted product. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply to you.

This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

For repair or replacement under the warranty please return the defective part of your Estes product with proof of purchase to:

Estes Industries
Customer Service Department
1295 H Street
Penrose, CO 81240

ESTES SPACE PROGRAM™

JOIN THE LARGEST ROCKET CLUB ON EARTH!

The Estes Space Program™ was developed to increase your fun AND perfect your skills while flying your rockets. The Estes Space Program™ is set up so that members can earn official Achievement Awards. These awards can be earned as you progress through the various aspects of model rocketry such as multi-staging, gliders, aerial photography and/or scale.

Your membership packet is loaded with the following exciting rocket items:

- The exclusive **Yankee Clipper™** flying model rocket, available only to the Estes Space Program™ (ESP). This high-performing, almost 45 cm (17-1/2") tall rocket flies on A8-3 (First Flight), B4-4, B6-4, B8-5 or C6-5 engines.
- **ESP Cloth Patch** - the official club emblem comes on a 51 mm (2") x 76 mm (3") patch.
- Full-color **ESP Decals** - an assortment of large and small decals, fantastic for decorating your Yankee Clipper™, your range box or anywhere else.
- A beautiful wall **Membership Certificate/Achievement Record** and a **Membership Card** - both identify you as a member of the Estes Space Program™. Attach your ESP Achievement Awards to the certificate.
- **Estes Space Program™ Stationery** for all your rocketry correspondence.
- Information on how to earn your first five **Achievement Awards**. The Awards come with a colorful cloth patch and four corresponding decals. So far, there are ten possible Achievement Awards.
- A Special Edition of the **Model Rocket News**. As long as you get Achievement Awards, you will continue to receive this information-packed newsletter, published three to four times a year.

Watch for some forthcoming additions and changes to this program!

ESTES SPACE PROGRAM™ EST 1443 $12.99

ESTES
Estes Industries
1295 H Street
Penrose, CO 81240

PRINTED IN USA

2919
9416